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ECONOMIC ADVISORY COUNCIL

COMMITTEE ON  
LOCUST CONTROL

THE LOCUST OUTBREAK IN AFRICA AND  
WESTERN ASIA IN 1937

SURVEY PREPARED BY  
B. P. UVAROV, D.Sc.  
SENIOR ASSISTANT

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## COMMITTEE ON LOCUST CONTROL.

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### TERMS OF REFERENCE.

THE committee's terms of reference are :—

To consider and report on—

- (a) means for the mass destruction of the Desert Locust *Schistocerca gregaria* Forsk., and other tropical African locusts;
- (b) methods for ascertaining the reasons for the periodic swarming of these species with a view to their control.

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**Preface by Mr. Francis Hemming, C.M.G., C.B.E., Secretary,  
Economic Advisory Council.**

THE six surveys\* of the present locust outbreak in Africa and Western Asia, prepared at the Imperial Institute of Entomology, which have so far been published, upon the recommendation of the Committee on Locust Control of the Economic Advisory Council, covered the six periods, 1925 to 1931, 1932, 1933, 1934, 1935 and 1936 respectively.

The present survey prepared by Dr. B. P. Uvarov, senior assistant, Imperial Institute of Entomology, in collaboration with Miss W. Milnthorpe, technical assistant, is in direct continuation of those summaries and describes the development in the locust situation up to the early months of 1938.

It will be seen from the present survey that the international co-operation which has been instituted for collecting information on locust breeding and movements continues to be both efficient and most useful. An example is to be found in the case of the Desert Locust, which is now in a quiescent period, there being no swarms. Of this species it is possible to say that a new invasion will not come without an adequate warning, since the situation in certain suspected outbreak areas is being watched closely. Indeed, some definite signs of incipient swarming of this species have been observed during the last two winters on the coasts of the Red Sea, and it has been found possible to suppress the first swarms of the gregarious phase, thus preventing their spread. This hopeful experience should serve as a powerful argument in favour of the establishment of special permanent organisations whose sole concern should be to undertake both a close supervision of all areas known to be able to produce incipient swarms, and also the suppression of outbreaks before they have a chance to develop into invasions of vast regions. It is gratifying to be able to record that preliminary arrangements for the establishment of such organisations for the control of outbreak areas on an international basis are progressing very favourably.

*Economic Advisory Council,  
Gwydyr House,  
Whitehall, London, S.W. 1,  
February 9, 1939.*

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IMPERIAL INSTITUTE OF ENTOMOLOGY

THE LOCUST OUTBREAK IN AFRICA AND  
WESTERN ASIA IN 1937

By B. P. UVAROV, D.Sc.,  
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## I.—THE DESERT LOCUST.

*Schistocerca gregaria* (Forskål, 1775).

(map 1.)

1. DURING the 1937–1938 period, further indications of an outbreak on the Red Sea coast of the Anglo-Egyptian Sudan and of Southern Egypt were received, and subsequent incursions of small swarms in Southern Transjordan, in Sinai and in the Western desert of Egypt were recorded.

### (a) The Moroccan-Senegambian area.

2. No swarms or hoppers of the Desert Locust were present in Morocco during the whole of 1937 and the early part of 1938.

3. Subsequent information has shown that the swarms present during the year 1935 in Mauretania and recorded as *Schistocerca gregaria* Forsk. (see paragraph 3 of the 1935 survey and paragraph 3 of the 1936 survey) were *Locusta migratoria migratorioides* (Rch. and Frm.). No swarms or hoppers of the Desert Locust have appeared in the colony since 1934.

4. No swarms or hoppers of the Desert Locust were reported from Senegal during the period January to April 1937.

5. No swarms or hoppers of the Desert Locust were present in Gambia, in French Guinea or in colonies further south, during the period under survey.

### (b) The Algerian-Nigerian area.

6. The Desert Locust did not appear in Algeria or Tunisia during 1937 or the early part of 1938.

7. No swarms or hoppers of the Desert Locust were present in Italian Libya during the period under survey. (A swarm which was not identified, was, however, reported from the Mletania el Abiar district of the Bengasi province, Cyrenaica, in May 1937.)

8. No swarms or hoppers of the Desert Locust appeared in the French Sudan during the period from December 1936 until December 1937.

9. In November 1936 a swarm, species unknown, flew south at Niamey, Niger Colony. No other locusts appeared in the colony from December 1936 until June 1937.

10. No swarms or hoppers of the Desert Locust were recorded in the Oubangui-Chari-Tchad during the period under survey.

## (c) The Sudanese-Arabian area.

11. The following paragraphs 12-15 should be read in conjunction with paragraphs 9-11 of the 1936 survey and form a continuous record of that outbreak.

12. No swarms or hoppers of *Schistocerca gregaria* were present during the period from May 1937 until January 1938 in the Anglo-Egyptian Sudan. A close watch was maintained over the whole of the Red Sea littoral from the Egyptian frontier in the north to the Eritrean boundary in the south. Local breeding by solitary adults began in January in the Tokar district. Towards the end of February hoppers of the gregarious phase appeared between Halaib and old Suakin, and oviposition had occurred near Dungunab and at Khor Arbaat. The occurrence of the gregarious phase, however, was locally regarded as being due to an invasion of the area by a flying swarm from outside the country, and not to the local breeding up of the solitary locusts. Between the 2nd and 10th March early stage hoppers in fairly large numbers were located north of Mohammed Qol (lat.  $20^{\circ} 54'$ ; long.  $37^{\circ} 06'$ ). The heaviest infestation was in the Dungunab area, but by the end of the month all the hoppers had been destroyed by control measures.

13. Towards the end of February 1938 some locusts were found near Om El Rous (lat.  $25^{\circ} 29'$ ; long.  $34^{\circ} 40'$ ) on the Red Sea coast of Egypt. Both the solitary and gregarious phases were represented. The numbers present increased south of Abrag (lat.  $23^{\circ} 27'$ ; long.  $34^{\circ} 40'$ ), and the area infested extended to Halaib in the Anglo-Egyptian Sudan. Large numbers were either pairing or ovipositing and hoppers had hatched and were forming bands. The sandy plains of the coastal region were affected. Control measures were immediately undertaken.

14. In June 1937 an outbreak of the Desert Locust was reported from the northern part of the Western desert of Egypt. The infestation extended along the whole coastal region from Amria (lat.  $31^{\circ}$ ; long.  $29^{\circ} 50'$ ) to Sollum on the western frontier, and reached to the south as far as the Siwa oasis (lat.  $29^{\circ} 15'$ ; long.  $25^{\circ}$ ). A large percentage of the adults and hoppers present belonged to the gregarious phase. Hoppers of all stages were present and fresh hatchings occurred during the month. Heavy rains had fallen in this part of the Western desert during the previous April. Further scouting, undertaken in July, revealed that localities north of the Kattara depression were included in the infested areas. A small outbreak of this species was also reported from Wadi-Mit-Matny near Hassana in Sinai. Prompt control measures were taken in each case, and by the end of July the areas in question were practically clear of locusts. No exact information was available regarding the origin of this outbreak.

15. No swarms or hoppers of the Desert Locust appeared Palestine for the period under survey.

16. As has already been recorded in the 1936 survey, in Trans-jordan a swarm of *Schistocerca gregaria* settled at Gueira between Ma'an and Akaba in April 1937, and was afterwards reported from Akaba going in a south-easterly direction.

17. Nil reports were received from Eritrea for the period February 1937 until March 1938.

18. No reports of locusts in Abyssinia have been received for the period under survey.

19. No locusts were present in the vicinity of Aden, Arabia, and no reports of locusts elsewhere in Arabia have been received for the period under survey.

#### (d) The Somali area.

20. No locusts were present in Italian Somaliland during the period from April 1937 until March 1938, and none were present in British Somaliland from November 1936 until December 1937.

#### (e) The Indo-Iranian area.

21. No swarms or hoppers of the Desert Locust were reported from Iraq, Iran and Afghanistan during the period under survey.

22. No swarms of *Schistocerca gregaria* were present in India during the period under survey. On the 23rd August, 1937, however, it was reported from Sardarshahr that a light swarm of grey-coloured locusts had passed over. It was believed that there had been a general migration of solitary locust individuals, at the time of the occurrence of dust storms, and that in some instances, such as that referred to above, a simultaneous migration of solitaires presented the appearance of a swarm.

#### (f) The South African area.

23. No locusts of this species were present during the period from May until September 1937 in South Africa. In October a few isolated fliers were observed in the upper Molopo area of the Upington district, but from November 1937 until March 1938 the Desert Locust did not reappear.

## II.—THE AFRICAN MIGRATORY LOCUST.

*Locusta migratoria migratorioides* (Reiche and Fairmaire, 1847).

### (a) The swarms of the seventeenth generation.

24. Paragraph 57 of the 1936 survey should be supplemented by a report from French Cameroon referring to September 1936, when a swarm flew south at Fort Foureau near Lake Chad.

### (b) The swarms of the eighteenth generation.

(map 2.)

25. Since at the time of publication of the previous survey, all the reports referring to the eighteenth generation had not been received, these have now been incorporated in the following paragraphs which should be read in conjunction with paragraphs 71–81 of the 1936 survey. The map (map 2) should replace map 6 of the 1936 survey, and represents a more complete picture of movements of swarms of the eighteenth generation.

26. Swarms enumerated in paragraph 3 of the 1935 survey and in paragraph 3 of the 1936 survey as Desert Locust swarms in Mauretania have in the light of subsequent information been shown to belong to the African Migratory Locust, and were swarms of the fifteenth generation. On the 13th March, 1937, a swarm belonging to the eighteenth was recorded as Sélibaby in Mauretania.

27. Some swarms appeared in the Basse Casamance area of Senegal in February. Except for one swarm which flew south-east at Ziguinchor, they were flying in no particular direction. In March three swarms remained in this area and moved south. In the Haute Gambie district, a swarm flew north-east at the end of the month. During April a large swarm flew east at Kédougou and subsequently divided into two parts, one of which continued east and the other south-east towards French Guinea. During May a swarm of unknown species flew north at Podor towards Mauretania, and in June three swarms of *Locusta migratoria migratorioides* which flew west were signalled in the east of the colony.

28. In January swarms flew west in the Kankan district, French Guinea, having come from French Sudan. Numerous swarms moved west and south-west across the colony and reached the coastal districts of Boké, Kindia, Forécariah, Boffa and Konakry and then turned south along the coast. By February swarms had concentrated in the western districts, except for two swarms which flew east in the Kankan district. The direction of flight continued to be to the south and south-west and some swarms entered Sierra Leone. Fewer swarms were present in March, and although they flew in various directions the main trend was eastward, since reports were then received from

the Kankan, Kindia, Téliélé, Mamou and Labé districts. In April swarms flew east in the Kankan district. In the west of the colony only four swarms were reported in the Mamou district and a single swarm in the Forécariah district. Egg-laying swarms were reported in May in the south-west of the colony. Three swarms moved east in the Gaoual district in the north of the colony, and in the Labé district several swarms were present. In June swarms in the Kouroussa and Kankan districts moved eastwards. Three swarms were reported from the Beyla district. In July a late egg-laying swarm was reported from the Dabola district.

29. No reports from Portuguese Guinea were received for the period under survey.

30. Three mature swarms were reported from Sierra Leone in April. Two flew south and one north-west, all in the same locality near Batkanu. Four swarms were reported in this locality in May and egg-laying took place. Some swarms were present in the Mange district (8°55' N. 12°52' W.) during June.

31. No reports were received from the Ivory Coast for the year under survey.

32. Mature swarms were circling in the Northern province of the Northern Territories, Gold Coast, in May.

33. No reports were received from Dahomey and French Togoland during the period under survey.

34. Some additional reports, which referred to March, were received from Nigeria when some swarms were reported from the Ofo, Bida and Oshogbo districts. The swarms present in April continued to be few and flight direction was various. All were between the 8° N. and 11° N. parallels. Reports were received in May from the Sokoto, Zaria, Katsina and Kano provinces and swarms flew east, north-east and north. Young swarms of the next generation were, however, present with the old swarms.

35. No swarms were reported in French Cameroon from October 1936 until April 1937, when a swarm flew from north to south and then turned east at Mokolo near Mora. No swarms were present in May or June.

36. No swarms were present in the French Sudan during February, but in March two swarms were signalled from the Sikasso district in the south of the colony. One flew west and the other north-west. Two other swarms were reported, but their determination was doubtful and they may have belonged to the Tree Locust, *Anacridium moestum*, which was also present in the colony. One flew east at San, and the other flew north-west at Macina. By April swarms had appeared from the south, and the majority flew north and east. Swarms were most numerous in the Bougouni and



Sikasso districts. Three swarms moving in a westerly direction were reported from the Ouahigouya district. Very numerous swarms were present in May, the majority being reported from the Bamako, Bougouni, Koutiala and Ouahigouya districts. Ovipositing swarms were present in the Ouahigouya district. Young swarms were recorded from the Bamako and Koulikoro districts which flew from the direction of French Guinea. There was therefore some overlapping of the eighteenth and nineteenth generations. The general trend of flight direction was north-east. Old and young swarms were present in the colony during June, and reports were received from districts further north than in the preceding month. The Kayes, Bafoulabé, Kita, Nioro, Bamako, Koulikoro, Kolokani, Mourdiah, Dioila, Bougouni, Sikasso, San, Ségou, Macina, Mopti, Ouahigouya and Tougan districts were invaded. One or two ovipositing swarms remained in the colony in July and were reported from the Kita, Bougouni, Macina and Douentza districts.

37. No swarms were present in the French Niger colony from August 1936 until the end of June 1937.

38. No swarms referable to the eighteenth generation appeared in the Oubangui-Chari-Tchad territories.

39. No swarms of the eighteenth generation were present in the Anglo-Egyptian Sudan.

40. No swarms were present in Eritrea, Kenya or Tanganyika for the year under survey.

41. No swarms appeared in Uganda until February 1938 and in the Belgian Congo until December 1937 (see below, paragraphs 90 and 91 respectively).

42. No swarms were recorded in Southern Rhodesia during the period under survey, and none from Northern Rhodesia from November 1936 to December 1937.

43. No swarms of this species appeared in Nyasaland, Angola, Portuguese East Africa or in the Union of South Africa during the year under survey.

#### **(c) The hopper areas of the nineteenth generation.**

(map 3.)

44. Hoppers appeared in Mauretania in June and July 1937 at Kow, in the M'But region of the Gorgol district.

45. Hoppers were reported in the central regions of Senegal in July and continued to be present in August. No further hoppers appeared subsequently in the colony during the period under survey.

46. By the end of May egg-laying and the appearance of hopper bands were reported from French Guinea. Egg-laying occurred in

the Forécariah, Mamou and Kindia districts, and hoppers were reported from the Dabola, Mamou, Forécariah and Kindia districts. Fairly numerous bands appeared in June in the Mamou, Forécariah and Kindia districts, and some bands appeared in the Dubréka and Yanguékori districts. In July further oviposition took place in the Dabola district, and hoppers were reported from the Dabola and Mamou districts. Hopper bands continued to be present in the Labé district in mid-August.

47. In Sierra Leone some bands of hoppers were present in the Kono district of the Southern province early in April. By May numerous bands were reported. The worst centres of infestation were the regions bordering the lower reaches of the Little Scarcies and Mabole rivers, where the conditions for locust breeding were very favourable. Some late-stage hoppers were reported from Batkanu during the early part of June.

48. Hoppers were reported at Geaka Zsafo. Grand Bassa country, Liberia, in early May. No further hoppers appeared during the period under survey.

49. Egg-laying on a comparatively extensive scale took place in the neighbourhood of Tamale in the Northern Territories of the Gold Coast during April. In May hoppers appeared on a larger scale than the previous reports of egg-laying had suggested, and in June bands were common in the vicinity of Gambaga and to a lesser extent in the Bawku district of the Northern Territories.

50. No hoppers of the nineteenth generation were present in the French Cameroon during the period under survey.

51. No previous egg-laying was reported in Nigeria, but in April hopper bands were present in the northern part of Ilorin province between Bode Sadu and Lafiagi. A single band was observed between Akerre and Wushishi in the Niger province. By May hoppers had become more numerous and were reported from all divisions of the Ilorin and Niger provinces and from the Koton Karifi division of Kabba. The infestation was very heavy along the railway between Jebba and Zunguru. Numerous bands were destroyed in the Bida division and several were reported from the Tiv division of the Benue province. Bands occurred late in the month between Iseyin and Shaki, Oyo province. In June hoppers were numerous in parts of the Kontagora division and were present in other divisions of the Niger province. The Zaria, Katsina and Sokoto provinces reported bands, and they continued to be present in the Kabba, Benue and Oyo provinces. Fewer reports were received in July. Bands occurred in the south of the Sokoto province and a few bands were present in the Zaria, Katsina and Bornu provinces. No hoppers were reported from the Southern provinces this month. In August one band was recorded near Ngale in the Dikwa division and another was seen north of Maiduguri, in the Benue province.

52. Egg-laying first occurred in the French Sudan in May, when some reports were received from the Ouahigouya district and one from the Nouna district. A single hopper band appeared at Koutiala. Some oviposition occurred in June, and scattered reports were received from the Kayes, Kita, Satadougou, Bafoulabé, Bamako, Nioro, Mopti and Macina districts. Very numerous hoppers were present, especially in districts south of the Niger river. Some egg-laying occurred in July in the Kita, Bougouni, Macina and Douentza districts. Numerous hoppers continued to appear and there was little change in the position. Reports were received from the Kayes, Kita, Satadougou, Bafoulabé, Nioro, Bamako, Koulikoro, Bougouni, Dioula, San, Ségou, Sikasso, Koutiala, Nouna and Ouahigouya districts. By August there was a considerable decrease in the number of bands present, and they continued to be reported only from the Nioro, Mopti, Niafunké and Ouahigouya districts.

53. No eggs or hoppers were present in the French Niger colony from August 1936 to June 1937.

54. No hoppers referable to the nineteenth generation appeared in the Oubangui-Chari-Tchad territories, or in the Anglo-Egyptian Sudan.

55. No hoppers were observed in Eritrea, Kenya or Tanganyika during the year under survey.

56. No eggs or hoppers of the nineteenth generation appeared in Uganda or the Belgian Congo.

57. No hoppers were present in Northern or Southern Rhodesia, Nyasaland, Angola, Portuguese East Africa or the Union of South Africa during the period under survey.

**(d) The swarms of the nineteenth generation.**

(map 4.)

58. At the end of June and beginning of July swarms were signalled in the Guidimaka district and in the Kaedi and Littama areas of the Gorgol district, Mauretania. No further swarms were recorded for the year under survey.

59. In July two large swarms were present in Senegal. These moved across the central and eastern regions of the colony. Swarms which flew in various directions were reported from these regions in August, and in September two swarms, one flying south and the other north-east, were signalled from Matam. No swarms were present in October.

60. In the Kindia district of French Guinea, two swarms which were probably swarms of the nineteenth generation flew north at the end of June. During July swarms of both the old (eighteenth) and new (nineteenth) generations were present together. Three swarms flew

north-east in the Kindia and Mamou districts, another east at Kankan, and in the Siguiri district a swarm flew north-east to west. These probably belonged to the nineteenth generation. In August swarms were more numerous and moved north-east in the Labé and Mamou districts towards the French Sudan. Some moved north across the Mamou district from the direction of Sierra Leone. Fewer swarms were recorded in September and all were in the north of the colony. Two flew south-west in the Gaoual district, three moved north in the Dabola district and two also going north were reported from the Labé district. In October some swarms circled in the Siguiri district but elsewhere in the Téliimélé and Mamou districts swarms moved south.

61. In June some young fliers derived from local hoppers appeared in Batkanu, Sierra Leone, and in July a swarm of newly emerged fliers was reported near Mange. From August until the end of December no further swarms appeared in the colony.

62. A small swarm was observed in May at Geaka Zsafo, Grand Bassa country, Liberia. During March and April the rains were lighter than at the corresponding period in previous years. No further swarms were recorded during the year under survey.

63. In the Gold Coast towards the end of May hopper bands in the vicinity of Tamale, Northern Territories, matured, and the resulting swarms circled and ultimately flew north-westwards into French territory. In June some young swarms passed near Tamale and Bawku, flying north-east into French territory. Only one swarm was recorded in July, which flew north-west and had probably arisen from unrecorded hopper bands in the sparsely populated country west of Salaga. On the 2nd August a very small swarm circled near the French Togoland frontier in the Gambaga district. No swarms were present in the colony in September, October and November.

64. In May fairly numerous young swarms were recorded in the Bamako district, French Sudan, which were moving north and north-east from the direction of French Guinea. Some young swarms were also recorded from the Koulikoro district. In June a few definitely young swarms were reported from the Bamako, Koulikoro, Mopti and Sikasso districts, but swarms were present in all the districts of the Niger valley and those to the south, and many of these were probably swarms of the nineteenth generation. By July a definite north-easterly trend of flight had set in and the eastern districts of the colony were the most heavily infested, the majority of swarms being concentrated in the Dioïla, Koulikoro, Koutiala, Mopti, Douentza, Niafunké, Ouahigouya, San, Ségou, Macina, Sikasso, Tongan and Nouna districts. Swarms were flying east and north-east in August, and egg-laying occurred in the Niafunké, Ouahigouya and San districts. Swarms were found further north in the colony, some reports being received from the Nioro, Néma and Timbuctu districts. In September there was a reversal of flight direction, and swarms

flew mainly west and south-west along the Niger and Bani river valleys and in the Kayes, Kita, Bafoulabé, Yélimané, Nioro, Nara, Mourdiah, Bandiagara, Sikasso, Koutiala, Ouahigouya, Tougan and Nouna districts. In October considerably fewer swarms were present and these flew southwards. In the Upper Volta region, French territory, in October, a swarm was observed to the north of Widinaba, Kusasi district of the Northern Territories, Gold Coast. Oviposition occurred in the Bougouni district. An egg-laying swarm continued to be present at Foulala in the Bougouni district in November.

65. Young swarms appeared in Nigeria in the Ilorin and Niger provinces late in May. In June numerous swarms were present in the Northern provinces, especially in the Niger, Zaria, and Katsina provinces. The main directions of flight were north and east. By July the number of swarms present had further increased, and most swarms were between the  $9^{\circ}$  N. parallel and the northern frontier. Swarms continued to move north and east. The majority of reports were received from the Sokoto, Zaria, Kano, Katsina, Bornu, Niger and Bauchi provinces. A single swarm flew east, towards Gashaka in the mandated territory of Adamawa. There was little change in the situation in August, except that slightly fewer swarms were present and some swarms flew south near Yola in the Adamawa province. There was a further decrease in the number of swarms present by September and egg-laying occurred. Swarms were now north of the  $10^{\circ}$  N. parallel, and were present in the Zaria, Katsina, Kano, Bornu and Bauchi provinces. In October there was an overlapping of the nineteenth and twentieth generations, since young swarms had also appeared. In addition to the areas invaded in the previous month, the Adamawa province was also invaded. Swarms had begun to fly south and south-west, but were north of the  $9^{\circ}$  N. parallel.

66. In July 1937 some swarms appeared in the southern regions of the Niger colony. These crossed the Niger from French Sudan and flew due east or north-east across the colony.

67. Numerous swarms were signalled in the Fort Foureau region of the French Cameroon in July and these were flying north-east and east, with the exception of a swarm which flew south on the 6th and another which flew west on the 21st. No swarms were present in the colony in August, but in September a few swarms moved south-eastwards in the Garoua, Guidder, Mokolo, Maroua and N'Gaoundéré regions. Eggs were laid near Maroua. In October swarms which probably consisted of both the nineteenth and twentieth generations continued to be present, and movement was mainly to the south-east. The Fort Foureau, Mokolo, Maroua, N'Gaoundéré and Garoua regions were invaded.

68. No swarms appeared in the Oubangui-Chari-Tchad territories until July 1937, when numerous swarms moving mainly north and

east appeared. These swarms, which had come from Nigeria, moved across the territory and ultimately entered the Anglo-Egyptian Sudan. Swarms were reported from the Moussoro, Massakory, Massenya and Fort Lamy districts. Swarms flew north over Ati in the Batha district, and at Abeshir in the Ouaddai district numerous egg-laying swarms were present. Other swarms appeared at Am-Dam by the end of the month. By August very numerous swarms were present and the direction of flight was various. Some swarms were present in the Bas-Chari and Mayo-Debbi districts. Numerous swarms were recorded from the Kanem and Batha districts. Egg-laying swarms were present in the Fort Lamy, Ouaddai and Baguirmi districts. Some large swarms flew south-east from Mongo, rested at Aboudeia, and later reached Am-Timan. Swarms were not so numerous in September, but reports were received from as far south as the Fort Archambault area. At Rig-Rig in the Kanem district some swarms flew north-east, and numerous swarms were present between Massakory and Moussoro. The Mayo-Kebbi district also reported numerous swarms. Egg-laying still continued during the month. Only a few swarms were reported in October, and it is possible that some of these may have belonged to the twentieth generation. Some swarms flew east near Melfi and a large swarm moved north over Massenya. A part of this swarm subsequently returned south-east. A swarm flew south-east and settled in the Bousso region near Massenya, and some swarms were present near Fort Archambault.

69. Invading swarms of western origin reappeared in the Anglo-Egyptian Sudan after an interval of two years at the end of July 1937, when swarms moving east entered the Darfur province from the Oubangui-Chari-Tchad territories. Reports were received from the Geneina, Kutum, Zalingei, Keb Kabiya and Wada districts. In August swarms were still confined to the Darfur province, and egg-laying occurred in the west of the Geneina district. Some swarms flew north in the El Fasher district, another moved west and another south. In September swarms continued to be present in the Darfur province. Two swarms flew east in the Marra district, one settled at Toya and at Darlinga a swarm flew north. Egg-laying continued at Dereisa in the Zalingei district, at Kamaling in the Geneina district and at Dali in the El Fasher district.

70. No swarms referable to the nineteenth generation appeared in the Belgian Congo or in Uganda.

#### (e) The hopper areas of the twentieth generation.

(map 5.)

71. No eggs or hoppers appeared in Mauretania after July 1937.

72. No eggs or hoppers were present in French Guinea during the period from September 1937 to March 1938 and none were present in Sierra Leone from July 1937 to March 1938.

73. There were no eggs or hoppers of the twentieth generation in the Gold Coast.

74. Overlapping of swarms of the eighteenth and nineteenth generations led to continuous breeding in the French Sudan. However, eggs which were laid in August in the eastern districts were most probably those of the twentieth generation. Reports were received from the Niafunké, San and Ouahigouya districts. In September egg-laying occurred in the Kayes, San, Ségou, Sikasso and Nouna district, and hoppers were present in the Kayes, Ouahigouya, San, Macina and Tougan districts. The Ouahigouya and San districts were fairly heavily infested. In October eggs were laid in the Bougouni and Kayes districts. There was a considerable increase in the number of hopper bands present, and the Macina district was badly infested. The Yélimané, Nioro, Nara, Mourdiah, Kayes, Bafoulabé, Bougouni, Sikasso, Koutiala, San, Ségou and Koulikoro districts were affected. Fewer hoppers were reported in November, but the Bougouni and Ségou districts continued to be overrun. In December one report was received from the Koutiala district, but the Bougouni district was still infested. Elsewhere in the colony the hoppers had disappeared. No further reports have yet been received.

75. Egg-laying occurred in September in the Zaria and Kano provinces of Nigeria, and the northern and eastern areas of the Bornu Emirate were heavily infested with hoppers. Bands also appeared in the Musawa district of Katsina late in the month. Oviposition continued in October in the Zaria and Kano provinces and at the end of the month was reported from the Adamawa province. Hoppers were widespread in the northern and eastern districts of Bornu, and were later reported from the Bauchi, Katsina, Adamawa, Zaria and Kano provinces. The infestation was heaviest in Bornu and Bauchi. By November reports of hopper bands were fewer, but they were reported from various districts in the Bauchi, Bornu, Kano, Katsina and Zaria provinces. A few bands appeared late in the month in the Zaria and Plateau provinces. None were present in December 1937 and in January, February, and March 1938.

76. On the 19th September some egg-laying occurred near Marous, in the Logone region of the French Cameroon.

77. In July in the Oubangui-Chari-Tchad territories, egg-laying occurred near Abeshr in the Ouaddai district and near Fort Lamy in the Bas-Chari district. Hoppers appeared in the Ati subdivision of the Batha district. In August a considerable amount of egg-laying took place, and numerous hopper bands appeared in the colony. Eggs were laid in various scattered localities in the Kanem, Batha, Ouaddai, Baguirmi and Bas-Chari districts, and hoppers appeared in the same districts and also in the Salamat district. Less oviposition took place in September, reports being received from Djermaia near

Fort Lamy in the Bas-Chari district, near Fort Archambault in the Moyen-Chari district and near Massenya in the Baguirmi district. Hoppers continued to appear in the same localities as in September, and in addition in the Mayo-Kebbi and Moyen-Chari districts. In October some hoppers were present at Aboudeia in the Salamat district. No hoppers were subsequently reported in November and December 1937 or in January, February, and March 1938.

78. Towards the end of August eggs and hoppers were reported in the Anglo-Egyptian Sudan in various localities of the western Geneina district, Darfur province. Hoppers were also recorded to the west of El Fasher, and large numbers occurred south of Kutum in the neighbourhood of Ain Kura at Tarma and between Gubba and Hamra. In September further oviposition was reported from Dereisa in the Zalingei district, from Dali in the El Fasher district, and from Kamaling in the Geneina district. Destruction of hopper bands was carried out during the month in the Geneina, Zalingei, and El Fasher districts. An isolated small band was reported on the 16th in the Wad Sharfai district of the Kassala province. No further egg-laying occurred in October, and many hopper bands had been destroyed, or reached the winged stage. Some bands continued to be reported in various localities of the Darfur province—Dar Masalit, Dar Gimir, Dar Jebel Sileia, Misteria, Giraf el Ahmar, Kudumi, Kheirban and Daiyu wells. In November only a single report was received from west of Buru (11° 38' N., 23° 31' E.) in the Darfur province. No further breeding occurred in the period from December 1937 to March 1938.

79. No eggs or hoppers of the twentieth generation appeared in Uganda or the Belgian Congo.

#### (f) The swarms of the twentieth generation.

(map 6.)

80. The following summary of swarms of the twentieth generation must be regarded as incomplete, since all the reports to be included have not yet been received. These will be incorporated in the next survey, and the following paragraphs must therefore be regarded as preliminary.

81. In November two swarms flew south-west in the eastern region of Senegal, and in December two swarms flying respectively south and north-west were reported from these regions. No swarms appeared in the colony during the period from January to March 1938.

82. In French Guinea in November some swarms came from the French Sudan and flew south-west across the Kouroussa district. Various swarms moving mainly south-west were signalled from the Mamou district. In December swarms continued to move west and south-west. A large swarm flew across the Macenta district and two



swarms flew due west at Faranah. Various swarms moved west in the Mamou district, and at Kankan a young swarm flew south-west. By January some swarms had reached the coastal districts. Numerous swarms were present in the Boké and Mamou districts, and scattered swarms were reported from the Dubréka, Forécariah and Dabola districts. In February and March the direction of flight was various. In February the majority of reports were received from the Kindia district, and in March from the Kindia and Mamou districts. In April, however, the majority of swarms were reported from the Kankan district, where they flew east or west. At Dabola a swarm flew south and another east, and at Kouroussa a swarm moved east. At Beyla a swarm flew from north-west to south-west.

83. In January 1938 some swarms reappeared in Sierra Leone, in the Kono district of the Southern province. On the 27th a swarm flew north-west near Batkanu. By February swarms were more numerous, although they were much fewer than at the corresponding month of the previous year. Some damage to rice crops in the Great Scarcies river area was reported. No swarms appeared in the south-west of the colony. At the end of March a mature swarm flew east near Batkanu, but no other swarms were present and it was probable that swarms had moved north as a result of unusually heavy showers of rain in February and March. No swarms were present in April, May, and June 1938.

84. In the Gold Coast two small swarms were recorded in December in the Northern Territories, one of which flew south-west near Tamale and the other north-east near Gambaga. "Harmattan" conditions prevailed in the Northern Territories during the whole of January and no swarms were reported from this area. After the beginning of the "harmattan" in the south, various immature swarms which either circled or flew south-west appeared at Ho, Kpeve, Senchi and Akuse. A small swarm flew west between Prang and Atebubu in northern Ashanti. In February strong "harmattan" conditions prevailed in the north and all swarms were located south of the 7° N. parallel. Further immature swarms invaded southern British Togoland during the first half of the month, and swarms came from the open country comprising the Afram plains to the north-west and from French Togoland. Swarms penetrated as far as Accra. The "harmattan" ceased in the south during the later half of the month, and the movements of swarms south-westwards after its cessation were abnormal, the usual directions being to the north and north-west. At Sawla, in the West Gonja district, Northern Territories, two swarms flew north. In March swarms were very numerous. Strong "harmattan" conditions continued to prevail in the north, and the majority of swarms were concentrated in the extreme south. During the latter half of the month, swarms in the extreme south moved eastwards and northwards. Swarms flew north at Kpeve and Peki, and some flew north, north-west and east respectively at Lawra, Northern Territories. In April, with the onset

of the rains, swarms moved north of the  $8^{\circ}$  N. parallel and began to mature early in the month. A large swarm flew east at Salaga, and swarms moving in various directions were present near Tamale. At Gambaga and Navrongo swarms flew north.

85. Young swarms were reported in the French Sudan in November and were flying in various directions. A few swarms were present in the north-west of the colony, in the Kayes and Niolo districts, but the majority were south of the Niger river. Various swarms were present in the Bamako, Koulikoro, Koutiala, San, Ségou, Macina, Sikasso and Tougan districts. By December there had been a considerable westerly movement, and the majority of swarms were reported from the Bamako district. Other reports were received from the Kayes, Kita, Bougouni, Koutiala and Sikasso districts.

86. In the middle of October swarms of recently matured adults appeared all over the Bornu Emirate, Nigeria. By November the number of swarms present in the colony had considerably increased. Most swarms flew west, south-west or south, except for some in the Adamawa province, which moved east. All the Northern provinces except Kabba and Ilorin were invaded and the Adamawa, Niger, Bauchi and Plateau provinces were heavily infested. A few swarms were reported in the southern provinces, from the Bamenda division of the Cameroons, and two swarms in the Ondo province and one in the Ogoja province. Fewer swarms were present in December and these were all further south than in November. The majority were south of the  $11^{\circ}$  N. parallel and in the southern provinces had almost reached Calabar. In January a definite westerly movement had set in. In the north the majority of swarms were reported from the Benue and Kabba provinces, and in the south reports were received from the Oyo, Ondo, Onitsha, Warri and Ogoja provinces and from the Cameroons. Fewer swarms were recorded in February and the flight direction was variable. The majority of swarms were south of the  $10^{\circ}$  N. parallel in the Abeokuta, Benin, Calabar, Ogoja, Ondo, Owerri, Onitsha and Oyo provinces and in the Cameroons. One swarm penetrated the forest at Sapoba in the Benin province. There was little change in the position in early March, but by the end of the month swarms moved north and were present in the Ilorin, Kabba, Zaria, Plateau and Benue provinces. At Ibadan a swarm broke up and many individuals died, possibly as a result of the unusually arid conditions accompanying a "harmattan" period which occurred early in the month. In April only one swarm remained in the southern provinces, near Shaki in the north of the Oyo province. Nearly all swarms were between the  $9^{\circ}$  N. and  $11^{\circ}$  N. parallels and flew westward. Egg-laying swarms were present in the Plateau and Niger provinces.

87. Immature swarms flew from west to south-east at Mokolo in the French Cameroon during October. In November various

swarms flew south and south-west at Yagoua, Garoua, Banyo, Dschang and Bétaré-Oya. Some had penetrated as far south as Batouri. Swarms continued to move south in December and were present at Yoko, Banyo, Bétaré-Oya, Bafia, Bangangté, Bafoussan and Dschang.

88. Various swarms were present in the Oubangui-Chari-Tchad territories in November. A large swarm flew south-east over Massenya, and near Fort Archambault in the Moyen-Chari district two swarms were present, one of which flew north-east and the other south-west. Further south in the territories swarms flew south in the Kémo-Gribingui district, and on the 9th a swarm was reported from Batangfo. On the 10th swarms were present in the Bossangoa sub-division and one flew south in the Bouca sub-division. A swarm flew south-west in the Boali sub-division, and one flew east along the Basse Kotto near Mobaye. Swarms were also present in the Bouar-Baboua sub-division throughout the month. In December a swarm flew east at Gounouman, north of Alindao in the Basse-Kotto district, and other swarms flying in various directions were present in this district. In the Bossangoa sub-division egg-laying swarms which flew mainly south-east were present. Some swarms flew south-west at Gribingui and in the Lobaye district, and some were reported near Carnot. In January 1938 the reports received were all from the south of the territories, where swarms were flying in various directions. Reports were received from the Ouaka, Bas M'Boumou, Ombella M'Poko, Kémo-Gribingui and Basse-Kotto districts. At Kouango a swarm flew north from the Belgian Congo. Numerous swarms remained in these districts during February, and the flight direction remained indefinite. Egg-laying was reported from Bakala in the Ouaka district. In March some swarms were present in the Basse-Kotto and Ouaham districts. On the 16th a swarm flew south at N'délé in the Dar el Kouti district.

89. In October in the Anglo-Egyptian Sudan a recently matured swarm flew west at Dar Gimir in the Darfur province. Other swarms flying south or west were present in the western districts of the province and successive swarms passed over Bir-Tabit. In November a single swarm was recorded which flew south-east over Zalingei. No swarms subsequently appeared in the colony until the end of February 1938 when a dense swarm flew west from Yambio in the Equatorial province. Another flew east in the same locality. At the beginning of March a small swarm flew south at Yambio, and at the end of March a large swarm flew south-west. During April numerous flying swarms invaded the Equatorial province, coming from the west and south-west. A swarm in the southern Darfur province flew east at the end of the month. In the south swarms reached Bahr el Arab and Bahr el Jebel, and some crossed the Nile north of Shambe and Bor and passed into the Torit district. These were egg-laying swarms. Fewer swarms were present in May and these were

reported from the Tonj district of the Equatorial province, from Radom and Huger on the southern boundary of the Darfur province and from the Juaibor district of the Upper Nile province. During June more numerous reports of flying swarms were received from the Equatorial, Darfur, Kordofan and Upper Nile provinces. A general migration of fliers to the north and north-east took place.

90. Swarms of this species, which was absent from Uganda since 1935, reappeared in that territory in February 1938. Two large swarms crossed the West Nile district north of Arua and flew north through Madi towards the Anglo-Egyptian Sudan. They had probably originated in the Belgian Congo. In March a large swarm came from the direction of Mahagi in the Belgian Congo and circled in the West Nile district, subsequently returning to Belgian territory. A second swarm appeared in the same area about ten days later. In April egg-laying swarms entered the West Nile district from the Belgian Congo and flew north-east. Eggs were laid in four localities in the north-west of the district.

91. In December in the Belgian Congo a large swarm flew over the area between Libenge and Bossobolo in the Ubangui district, and on the 20th another swarm flew south-east in the same region. At the end of the month a swarm flew west over Bili in the Uele district, and in January a swarm flew north-west over Dungu in the same district. Numerous swarms were present during February in the Kibali and Ituri districts and these were flying in various directions. Some, however, moved east across the Uganda border. In March various mature swarms were signalled near Aba and Faraje in the Kibali district. Swarms probably entered the north of the colony from the Oubangui-Chari-Tchad territories and the Anglo-Egyptian Sudan.

### III.—THE RED LOCUST.

*Nomadacris septemfasciata* (Serville, 1839).

**(a) Additional data on the final migration of the swarms of the tenth generation.**

92. Since the preparation of the 1936 survey, some additional data have been received referring to the swarms of the tenth generation in Portuguese East Africa and in Angola. The following paragraphs should therefore be read in conjunction with paragraphs 126 and 131, respectively, of the previous survey.

93. Very few swarms were reported in Portuguese East Africa during February 1937. In the Niassa province two swarms flew north over Metonia going towards Rovuma, and one swarm was reported from Montepuez in the Porto Amelia district. Another settled for some hours in the Quissanga district and later flew off south towards Porto Amelia. In March a few swarms of the old generation still remained. They were present in the Barué district, Zambesia province. One swarm flew west and another north-west towards the Rhodesian frontier. In the Sul do Save province, swarms were signalled in the Maputo district and in the Goba-Impamputo region, but the age of these swarms was not indicated.

94. In Angola numerous swarms were present in February and oviposition continued. There was no particular flight direction and swarms were recorded in the Luanda, Malange, Benguela, Bié and Huila provinces. By March very few swarms remained. Flying swarms were encountered at Cambembe in the Quissama district, Luanda province, and oviposition occurred in the Duque de Bragança district, Malange province, and in the Luchazes district, Bié province.

**(b) The hopper areas of the eleventh generation.**

(map 7.)

95. Egg-laying was first reported in Northern Rhodesia in the Kalomo district on the 30th November, 1936. In December no egg-laying was recorded. Very few swarms were present, but a high proportion of the females were gravid. In January, however, oviposition was fairly extensive and occurred in scattered patches in the Lukasashi valley, the highlands east of Mkushi, the southern Broken Hill district, the south of the Mumbwa district, and in the extreme north-east of the Namwala district. The largest concentration covered several square miles to the south of Broken Hill.

96. Hoppers emerged in Northern Rhodesia during February, and the infestation covered those districts where egg-laying had previously taken place. In March the position remained unchanged, but in April small bands of hoppers were reported in the west of the

Isoka district. Elsewhere in the colony by the end of the month the majority of hoppers had reached the sixth stage. Some hopper bands were still present in the Broken Hill district in May, but by this time the majority of hoppers in the colony had either been destroyed or given rise to young swarms of the next generation.

97. In Southern Rhodesia no egg-laying relating to the eleventh generation was recorded. However, large mature swarms were present in the colony until January 1937, and it is certain that egg-laying occurred unnoticed in some areas.

98. Hoppers appeared in Southern Rhodesia in January, when the Lomagundi and Wankie districts were affected. At the end of February a small outbreak of hoppers was reported near the Kariba gorge in the Zambesi valley. No hoppers appeared as a result of the presence of flying swarms in the occupied parts of the northern districts of the colony during the latter part of January. No locusts whatever were present during March and no hoppers were reported during April, although during March and April hoppers appeared in neighbouring territories. While no hoppers in swarm formation appeared on the higher veld during the season, several specimens of last-stage solitary hoppers were taken in the Mazoe district during May, indicating that breeding by scattered adults did occur.

99. In Nyasaland egg-laying had commenced by the middle of December 1936 in most districts of the Southern province. Reports indicated that although eggs were laid over large areas the egg-packets were scattered. Egg-laying continued throughout January in most of the southern districts and was fairly extensive in the Liwonde, Balakas and Fort Johnston areas. Reports were also received from the Bwanje valley, the lake shore areas of Dedza and Dowa, and areas east and south of Nchisi to the south of the Kota-Kota district. Very scattered egg-laying occurred in Native-Authority-Kapadula's area, Lilongwe district. A doubtful record of oviposition in the south of the Lilongwe district was received in February. In general, a more extensive area was laid over than in the previous year.

100. Hoppers hatched during January in the southern areas of Nyasaland from the December egg-laying. They appeared on a small scale south of Chiromo, Lower Shire district, but were more numerous towards Chikwawa. By the middle of the month hoppers were present in the Central Shire district and in the Mlanje district. General hatching occurred over the Liwonde, Balakas and Fort Johnston areas during the month, hopper bands being thickest in the vicinity of the Nkazi river, Upper Shire district, and to the north and east of Kawinga. By the end of the month hoppers were beginning to hatch in the Bwanje valley, Ncheu district. Hoppers also appeared in the Dowa and Dedza districts. There was little change in the general position in February. The Port Herald and Chiromo areas, Lower Shire district, reported only a few small bands, but the Chikwawa district was more heavily infested than in the previous year,

particularly in the uninhabited tract of country in the north-west of the district. Numbers of small hopper bands extended through the Central Shire district along the Shire valley into the Upper Shire and South Nyasa districts, but on the whole they occurred mainly in the long grass and did little damage to crops. The presence of the fungus disease *Empusa grylli* was noticed on a small scale in some areas, more particularly on fourth and fifth stage hoppers. There was a heavy infestation along the Bwanje valley, Ncheu district, extending to the shore areas of the Dedza and Dowa districts. Considerable hatching of hoppers was reported from the southern foothills of the Kota-Kota district. In March the situation was practically unchanged. The month was unusually dry and favourable to the rapid development of hoppers, so that flying swarms appeared in some areas. Late hatchings occurred in the higher elevations of the Dowa district, but Fort Manning and the more northern districts appeared to have remained free. No further hatchings were reported in April.

101. No egg-laying was reported in Portuguese East Africa until December, when some took place at Umbeluzi in the Maracuane district and on the banks of the Incomati river in the Magude district, both in the Sul do Save province. No other instances of egg-laying were reported in the rest of the colony during the month, although it is probable that egg-laying did occur, since swarms ready for oviposition were present. In January more reports were received. In the Niassa province eggs were laid in several localities in the Lurio area of the Porto Amelia district and in various areas of the Mozambique district, at Meconta, Mome, Ribaue and Angoche. In the Zambesia province reports were received from the Mandie, Macossa, Mungari and Changara areas of the Tete district, and from the Sul do Save province from numerous areas in the Sabie and Maputo areas of the Lourenço Marques district. No further egg-laying was reported in the colony.

102. On the 10th October, 1936, bands of hoppers were reported near Massinga in the Sul do Save province, Portuguese East Africa. No previous egg-laying had been reported in the colony and no hoppers had yet appeared in any part of the colony liable to infestation by *Nomadacris septemfasciata*. However, in the Magude area of the Lourenço Marques district, Sul do Save province, some *Locusta migratoria migratorioides* were present in a swarm of *Nomadacris septemfasciata* at this time. No hoppers were reported during November, and in December a single report of hoppers in the Murrumbene area, Inhambane district of the Sul do Save province, was received. By January hoppers had appeared in the Huenados and Mandio regions of the Tete district, Zambesia province, and were also present in the Luabo and Marrumeu districts, along the Zambesi River. Numerous hopper bands appeared in the Murrubane, Cabo Matingane, Massinga, Panda and Marrumbene areas of the Inhambane district, Sul do Save province. The Catuane and Magude areas

of the Lourenço Marques district were also infested. Hoppers continued to appear during February, and reports were received from the Meloco, Lurio and Chiure areas of the Porto Amelia district and from the Meconta area of the Mozambique district, Niassa province. In the Tete district, Zambesia province, hopper bands were numerous, and in the Mutarara, Luabo, and Marrumeu districts hoppers were reaching the winged state. The Inhassunga plains of the Inhambane district, Sul do Save province, were affected. There was little change in the general position in March. However, the Zambesi valley, notably in the Sena and Chemba regions, the borders of the Massingire and Mutarara areas and the territory of the Moçambique Company was very heavily infested. In the Sul do Save province numerous hoppers appeared in the Inhassune and Cogue areas of the Inhambane district and in various areas of the Lourenço Marques district. In April no hoppers remained in the Niassa province and in the Zambesia province only a few bands were present in the Tete district and in the Zambesi region of the Quelimane district. The Inhambane and Lourenço Marques districts, Sul do Save province, reported the presence of some hoppers. In May hoppers were present in the Lurio area of the Porto Amelia district, Niassa province, but elsewhere hoppers had disappeared from the colony.

108. Egg-laying was reported from the Vryheid district of northern Natal, Union of South Africa, in October 1936, but as all other available reports from this area indicated that swarms had not yet attained sexual maturity, it appeared unlikely that egg-laying of any importance could have occurred. Towards the end of November, egg-laying commenced in several localities. Extensive deposits were reported from northern Zululand and some egg-laying took place at Barberton, Transvaal, to the north-west of Durban and in areas in the vicinity of Umzinto and Port Shepstone, Natal. In Bechuanaland oviposition occurred in the Palapye district, and large egg-deposits were reported in the Bakgatla reserve. By December there was a considerable amount of egg-laying in the Union. Zululand, the coastal districts of Natal, the Zeerust, Potgietersrust and eastern Zoutpansberg districts in the Transvaal, various districts of the Orange Free State and the Kokstad and Bizana districts, north-eastern Cape province were affected. Swaziland was generally infested except for the south-western area, and eggs were laid in some districts of eastern Bechuanaland. In January egg-deposits continued to be reported in the eastern coastal districts of the Union, to the north of the Great Kei river, in various areas of the western Transvaal, in the Senekal district of the Orange Free State and in the Kweneng and Vryburg districts of Bechuanaland. In February some reports of egg-laying continued to be received from the Mafeking and Vryburg districts of Bechuanaland, the Wolmaransstad and Kregstad districts of the Orange Free State and the coastal districts of southern Zululand. Intense heat and drought conditions prevailed during December in the western half of the Transvaal, in adjoining



areas of the Cape province, and in the Bechuanaland protectorate. The first egg-deposits were thereby decreased. Egg parasites, mainly *Stomatorrhina lunata*, gave some assistance in reducing the outbreak, but unfortunately the attacks were very localised and therefore not of great practical importance. Otherwise the season was, on the whole, favourable for the hatching of eggs, and, in consequence, the subsequent hopper outbreaks were of a heavy nature.

104. By December hoppers appeared in the Union of South Africa. Outbreaks occurred on an appreciable scale in some areas of Natal, in the Marico and Bloemhof districts of the Transvaal and in Ngamiland and north-eastern districts of Bechuanaland. By January outbreaks on an extensive scale were general. Swaziland, and all the coastal districts of the Union north of the Great Kei river, were heavily infested. Various districts of the Orange Free State and of the Transvaal reported the presence of numerous hopper bands. In Bechuanaland hatchings occurred on a smaller scale than had been anticipated as a result of the effects of heat and drought. In Ngamiland birds acted as effective control agents. The earlier hopper outbreaks were successfully controlled in the different areas, but in February further outbreaks occurred. Hoppers were reported in the eastern areas of Swaziland, and in the coastal districts of the Union, as far south as Elliotdale. Owing to the favourable climatic conditions at this time in the northern districts of the Cape province, and in the western and north-western Transvaal and Orange Free State, the later hopper outbreaks were on a more extensive scale than had been anticipated. Outbreaks of fair dimensions occurred in the eastern section of the Bechuanaland protectorate. During March hoppers continued to appear in eastern Swaziland, in the north-western and northern districts of the Orange Free State, some western and southern Transvaal districts, and in a number of districts in the Transkeian territories. Eastern Bechuanaland continued to be infested, and outbreaks occurred at Rakops as well as at Nokannon on the western side of the Okavango swamps. These later hatchings were, however, controlled mainly in the initial stages of development. By April the majority of hopper bands had either been destroyed or had given rise to fliers of the new generation. Some late outbreaks were dealt with in various districts. The heaviest hatchings occurred in Pondoland and northern Zululand, but small scattered outbreaks also occurred in various districts of Natal, in the north-eastern Orange Free State and in the Klerksdorp, Potchefstroom and Zoutpansberg districts of the Transvaal. Light infestations were dealt with in a few places in the Transkei. In Bechuanaland hoppers still remained at Mochudi and Palapye. In May the Union was clear of hoppers, with the exception of one or two localities in the lower Tugela area, and as late as June some hopper bands persisted in the Pietermaritzburg district of Natal.

105. No Red Locusts were present in South-West Africa from February until the end of April 1937. In May, however, numerous

bands of sixth-stage hoppers were reported from the area north of the Etosha Pan. No further eggs or hoppers were reported in the territory.

106. Definite reports of egg-laying were received from Angola in December 1936, from the Quilengues area of the Huila district, Huila province. In January oviposition was reported from the Cambambe district of the Luanda province, and from Libolo in the Benguela province. In February there was some increase in the amount of oviposition, and reports were received from Dendo in the Luanda province, the Duque de Bragança district in the Malanje province, the Bié and Luchazes districts in the Bié province, and from the Quilengues district in the Huila province. As late as March egg-laying still continued in the Duque de Bragança district and at Cassamba and Muié in the Luchazes district.

107. Hoppers first appeared in Angola in January at Assango in the Amboim district, Benguela province. In February numerous hoppers were reported in the Icolo-e-Bengo and Dondo regions of the Quissama district, Luanda province, and bands were present in the Libolo district, Benguela province. By March there was a considerable increase in the number of hopper bands present in the colony. Large bands occurred in the Cassoneca and Cambambe districts and at Icolo-e-Bengo, Luanda province, and in the Luchazes district, Bié province. The Caconda and Capelongo regions in the Quipungo district, Huila province, were infested. There was little change in the position in April, and in May and June hoppers continued to be present at Icolo-e-Bengo and Cambambe in the Luanda province, and in the Luchazes district, Bié province. Some hoppers appeared at Capola in the Porto Amboim district, Benguela province. No further hopper bands appeared after this time.

108. No eggs or hoppers belonging to the eleventh generation were reported from the Belgian Congo.

109. No eggs were laid in Tanganyika Territory until January 1937, when two swarms moving northwards laid their eggs over a limited area to the north of the Songea district. No further egg-laying was reported.

110. Hoppers were reported in January in Tanganyika Territory in the Bugufi district, Lake province, near the Ruanda-Urundi border. In February hoppers had appeared in the Mahenge district, Eastern province, at Songea, Southern province, and at Lake Manyara in the Arusha district, Northern province. In March further hatching of hoppers was reported in the Lake province, on the Ruanda-Urundi border. All hopper bands in inhabited areas were practically destroyed by this time, but scattered bands in uninhabited areas were approaching the flying stage. In April small groups of hoppers remained in the Songea and Mahenge districts, but these were satisfactorily dealt with by local inhabitants. A few scattered

bands in uninhabited country in western Biharamulo reached the flying stage during the month.

111. No eggs or hoppers of the eleventh generation were present in Kenya.

112. Egg-laying occurred in Uganda in the eastern Toro district as early as the 25th September. In October there was a considerable amount of oviposition in the Entebbe district and some in the southern Mubende and in the Masaka districts. Egg-laying continued during November at a few localities in the Masaka, Mubende and Entebbe districts. In December only one instance of egg-laying in the southern Masaka district was recorded.

113. Hoppers were reported in the extreme east of the Toro district, the south-west of the Mubende district, the west of the Entebbe district, and in the north-west of the Masaka district, Uganda, in November. Hopper bands persisted in the above areas during December. A considerable reduction in their number was effected by ring-burning and beating on the part of the local inhabitants in Masaka and Mubende. In January the hopper infestation continued in south-west Mubende and in the adjoining part of Toro and in the Masaka district. A few bands were also present in the Entebbe district and in the north-west of the Ankole district. Hot, dry conditions were prevalent, which favoured the rapid development of the hoppers. The infestation continued during February in the Mubende district, although Toro was then free. Bands were present in several areas in the Masaka district, and in the Entebbe and Ankole districts still occupied the areas where they were reported in January. In March hoppers were still present in a few localities in the Masaka district and in one in the Mengo district. Hoppers continued to be reported near Lake Wamala and at one locality in the Masaka district in April.

### (c) The dispersal of swarms of the eleventh generation.

(map 8.)

114. Young swarms of the new generation first made their appearance in the Union of South Africa in April. Reports were received from Ilabisa, Natal, and near Kroonstad, Orange Free State. Three swarms were reported from northern Swaziland, one of which flew south. In May a few swarms were present, some on the border of Portuguese East Africa and some in the eastern areas of Natal. In June the Union was clear of Red locusts with the exception of some small swarms which were present in northern Zululand. In Swaziland a small swarm was recorded from Mhlotseni on the southern border. During July several flying swarms were reported from the vicinity of Stanger in Natal and also from Melmoth in Zululand, but the position on the whole remained favourable. In August a few flying swarms were reported from Ingwavuma and

Melmoth in Zululand and from Eastcourt in Natal. Early in September a fair sized swarm was reported from Flagstaff in the Transkei. From April until the end of September no swarms were reported in Bechuanaland.

115. No swarms of the eleventh generation were present in South-West Africa until June, when some swarms were in evidence in the area north of the Etosha Pan. No further swarms appeared in the protectorate until August, when two swarms were present in the Rehoboth district, one of which flew west and the other south-east.

116. Young swarms did not appear in Northern Rhodesia until May, although by April they had appeared in neighbouring colonies. During May swarms flew mainly west across the Broken Hill, Mankoya, Namwala, Lusaka and Mazabuka districts. Except for two large swarms, one near Broken Hill and one near Magoye, reports referred to loose aggregates of fliers, varying from groups covering a few hundred square yards to small swarms up to about a mile in length. These most probably moved into Angola, since in June only a small swarm flying west was signalled from the Lunyuwe river in the north of the Balovale district. In the east of the colony, however, two medium sized swarms appeared in the Mpika district and flew north-west, to disappear in the northern part of the Bangweulu lake and swamp area. These had come from east of the Loangwa river. In July a few swarms were reported from the Mwinilunga district. These were moving west and north-west. No swarms were reported from the western districts of the colony in August, but early in the month a huge swarm passed up the Luangwa valley and flew across the eastern Mpika district towards Isoka. On the 27th a large swarm settled at Isoka and flew west the following day. Smaller swarms also moved west at Isoka and near Kasama and had evidently come from Nyasaland. Small swarms were present at Fort Jameson. In September a few small swarms continued to be present in the Kasama and Serenje districts. Several flew north across the Kawambwa district. Swarms were much less numerous in the protectorate than during the corresponding period of the year 1936.

117. Young swarms appeared in Southern Rhodesia in April. The north-eastern districts, including Lomagundi, Darwin, Mazoe, Mrewa, Mtoko and Inyanga were invaded, apparently from Portuguese East Africa, where they had matured in the low veld of the Zambesi valley and in the Moçambique Company's territory. Flight directions were indefinite. There was little change in the position in May, and in June only a few large swarms were present in the Lomagundi, Mazoe, Salisbury and Hartley districts. In July still fewer swarms were present. A few swarms which flew in various directions remained during August in the Salisbury, Sebungwe, Lomagundi and Umtali districts.

118. As early as the middle of February young winged locusts were reported to be fairly common on the Luabo and Marrumeu

Sena Sugar Estates, in the Zambesi valley, Portuguese East Africa. By March in the Zambesia province, various swarms which had hatched locally were present at Mutarara together with swarms which had come from Nyasaland and were flying in no definite direction. In the Tete district many locusts reached the winged stage at the end of the month. Swarms were also present in the Sul do Save province in the Lourenço Marques and Maputo districts, but their age was not indicated. Various swarms were present in April in the Tete district of the Zambesia province. These flew mainly in various directions but some moved towards the border of Southern Rhodesia. A great number of locally bred young fliers appeared in the Quelimane district. Young swarms moved south towards Union territory in the Lourenço Marques district, Sul do Save province. In May there was a considerable increase in the number of swarms present. In the north of the colony, in the Niassa province, there was a definite migration northwards. Swarms moved due north over Erati, Nacala. Ribaué and Malema in the Mozambique district, eventually crossing the Lurio river. They continued north in the Porto Amelia district, passing over Macondes. Mucojo and Montepuez, and moved towards the Tanganyika Territory. In the Tete district, Zambesia province, swarms continued to be present near the Southern Rhodesian border, and in the Mutarara and Massingire districts swarms moved north-west into Nyasaland. Young swarms continued to be present in Luabo and Marrumeu on the Sena Sugar Estates territory. In the Lourenço Marques district, Sul do Save province, swarms which flew in various directions were reported from Guija, Sabie, Chibuto and Namahacha. By June the northward movement had ceased. Various swarms remained in the Maconde district, Niassa province, near the Tanganyika border, and a few swarms flying in no defined direction were present in the Mucojo district. On the 23rd a large swarm flew from Nyasaland across Metarica, Mozambique district, and flew north-east towards the Rovuma river. A swarm at Nampula flew from east to west. No swarms were reported from the Zambesia province during June, except for a few swarms which continued to be present at Luabo and Marrumeu in the lower Zambesi valley. In the Sul do Save province a few swarms were present in the Inhambane and Lourenço Marques districts. Small swarms flew north up the Limpopo river in the Chibuto region. Very few swarms were reported in July and these were all in the south of the colony. A swarm flew east from Southern Rhodesia into the Barué district, Zambesia province, at Vila Gouveia at the end of the month. In the Sul do Save province a few swarms were reported in the coastal region of the Inhambane and Lourenço Marques districts, where they flew either north or south. Few swarms continued to be present in August. Two flew south from Tanganyika, passing Nangade and Mocimboa do Rovuma in the Porto Amelia district of the Niassa province, and two were present at Maniamba near Lake Nyasa in the Mozambique district. In the Tete district, Zambesia province, a small swarm flew north-west over Furacungo, and a swarm in the

Barué region flew south across the Pungue river. A swarm flew north in the Muchopes region of the Inhambane district, and two flying north and south respectively were reported in the Bilene region of the Lourenço Marques district.

119. By March in the Tanganyika Territory young fliers developed from local hoppers near the Ruanda border in the Bugufi district, Lake province. In April more locusts reached the flying stage in western Biharamulo, Lake province, and during May scattered swarms moved north at Karagwe in the Bukoba district near the Biharamulo border. In June swarms continued to be present in the Bukoba and Biharamulo districts. Meanwhile, in the south of the Territory, swarms crossed the Rovuma river from Portuguese East Africa and invaded Newala in the Southern province. Swarms continued to move north, and two were reported from the Liwale district, one of which continued along the coastal plain and reached the Bagamoyo district. The northward movement continued throughout July. In the eastern province swarms passed over Bagamoyo, Rufiji, Mpanganya, Ruvu and Duthumi. Immature swarms moved north through the Tanga province. A swarm in the Northern province moved westwards through Masailand and was observed in the Rift valley south-west of Arusha. In the Bukoba district, Lake province, swarms continued to be present near the Uganda border. No more swarms entered the Territory from the south in August. A small swarm flew north through eastern Morogoro early in the month, and a swarm flew from south to west over Ngerengere in the Eastern province. In the Northern province, some swarms passed over Mbulu going towards Lake Eyassi, and a large swarm flew south over Mkalama, Central province. The rest of the swarms appeared to have settled in uninhabited country.

120. The Red Locust was not present in Kenya until July 1937, when a large swarm was reported. It had probably originated from Tanganyika, where there was a northward migration at this time. The swarm appeared in the Embakasi area and flew north-east. It divided into two parts, of which one settled in the Forest Reserve, north-east of the Uplands station, while the other flew over the Kiambu Reserve, north of Ruiru, and in August headed south near the Athi river and disappeared.

121. In February a young swarm of the new generation was observed in Uganda, between Mubende and Lake Wamala. The hot, dry conditions then prevalent favoured the rapid development of the hoppers. Subsequent reports have shown that the swarms present in March and attributed to the tenth generation (see paragraph 123 of the 1936 survey), belonged to the eleventh generation. In March young swarms had appeared in the Mubende, Toro and Bunyoro districts. Swarms in the Mubende district flew north-west. In the middle of the month a swarm entered the Ankole district from

Tanganyika and flew towards Kigezi. By April swarms were more numerous and were present mainly in the Mubende and Bunyoro districts. Flight direction assumed a northerly tendency. A large swarm invaded Acholi from Bunyoro and reached the extreme north of the former district. During May the northward movement was maintained. Some of the Acholi swarms invaded Madi, and flew on northwards towards the Anglo-Egyptian Sudan border. Swarms entered the Ankole and Masaka districts in the south of the protectorate, from Tanganyika. Single swarms were present in the eastern Toro and western Mengo districts. The situation during June remained similar to that in May. Swarms in the north-west of the colony continued to move towards the Sudan and the invasion from Tanganyika in the south continued. There was, however, some lessening of the infestation in the Gulu, Bunyoro and Mubende districts. A swarm flew north-west in the West Nile district. Numerous swarms continued to be present in July, but there was no longer any obvious northerly trend of flight. The majority of swarms were confined to the Ankole, Kigezi, Toro and Mubende districts. A large swarm (species not determined) entered Uganda from Gatsibu, Ruanda territory, during the month, and flew over the Ankole district. During August numerous swarms remained in the western districts of the colony, but no particular direction of flight was evident.

122. The northward migration of swarms in Uganda described in the preceding paragraph resulted in the Red locust appearing in the Anglo-Egyptian Sudan for the first time in the history of the present outbreak in June 1937. Two swarms at least were present in the Yei river and Moru districts of the Equatorial province during the month. One was observed at Ngere and later at Ndaraga, Walla and Ruba, moving steadily northwards. The other appeared at a point about twenty miles to the south-east of Yei and was later signalled between Lalyo and Amadi. By July swarms had penetrated a considerable distance further north, since reports were received from Malakal in the Upper Nile province and later in the month from Kosti in the White Nile province, Jebel Dub, Singa and Leweisa in the Blue Nile province, and to the north-east of Gedaref in the Kassala province. It was possible that these reports all referred to the movements of the same swarm. In August swarms had reached still farther north, and on the 19th of the month a swarm flew south-east at Abu Hamed in the Northern province. A large swarm flew backwards and forwards at Zeidab in the Northern province, and stragglers were observed at Shendi and in the vicinity during the month. A small swarm flew west at Shambe in the Upper Nile province, and in the Kassala province three swarms were reported between Kassala and Kashm el Girba. The only report for September was of a dense swarm of fliers which passed over Yei in the Equatorial province and then returned to fly east towards the Uganda border. No further swarms of the Red locust were reported in the Sudan.

123. No locust swarms were present in British Somaliland from January to March 1937, but during the second quarter of the year a swarm, species unknown, was observed in the colony. No further details were available and no further swarms subsequently appeared.

124. Flying swarms appeared in Nyasaland in March, an unusually dry month having been advantageous to the development of the hoppers. The earliest swarm was recorded on the 10th to the south of Port Herald. Other swarms were reported from the Mlanje, Chiradzulu and Central and Upper Shire districts. In April more swarms appeared. The main concentration occurred along the Shire and Bwanje river valleys and on the south-western shores of Lake Nyasa. Considerable circling flights were recorded in the Shire Highlands and Central Shire district and the usual movement from lower to higher levels occurred. The trend of flight was to the north and north-west. Swarms continued to fly north-west in May. Only three swarms were reported during May and June from the lower river districts, all of which eventually moved north into the Cholo hills. The tendency to move north and west resulted in June in a rather heavy infestation of the western border hills of the Ncheu district. Swarms moved up the Shire valley and from the western and southern lake shores into the Angoniland plateau as far as the Dedza, Dowa, Lilongwe and Fort Manning districts. Swarms flew towards the Northern Rhodesian border from the latter district. The more northerly part of the protectorate remained free of swarms. Fewer swarms were present in July and rather cold weather kept the swarms quiescent. A single swarm was reported from the Central Shire district which flew south-west from the Ncheu hills and a few swarms circled in the Zomba and Mlanje mountains. A large swarm entered the Mombera district from Lundazi, Northern Rhodesia, later turned back at Ekwendeni towards the Northern Rhodesian border. Some small swarms continued to move north in the Fort Manning districts during July and August. There was little movement of swarms during August. Some large swarms were present in the Dedza district and in the Mlanje and Zomba districts. A swarm flew from the North Nyasa district into Northern Rhodesia near Katumbi.

125. No swarms of the Red locust were reported from the Belgian Congo until May 1937, when towards the end of the month a swarm appeared in the Gahinga chieftdom. Ruanda, flying from south to north and then returning. A swarm was also signalled from the shores of Lake Albert, which flew towards the Semliki river near the Uganda border. In June a swarm circled over Mahagi on Lake Albert, and in the Ruanda territory a swarm coming from the south flew eastwards at Mehanda going towards the Tanganyika border. On the 17th a swarm was seen in the Banningville region flying from west to east and then returning west. During July a swarm flew south-east from Kinzia on the Kasai river. In August a swarm flew



east and another west at Kahemba in the Kwango province near the Angola boundary.

126. Flying swarms were present in Angola in April. Their age was not indicated, but most probably they belonged to the eleventh generation. Two large swarms moved north across the Cuanza river at Cambambe, Luanda province, and large swarms were present in the Libolo district, Benguela province. Some flew south at Vila Arriuga in the Huila province. In May several swarms passed over Icilo-e-Bengo and Cambambe, Luanda province, and several swarms flying south-west were seen at Calulo, Benguela province. By June there was a considerable increase in the number of young swarms present and flight direction was various. Very numerous swarms were reported from the Huila province, and other reports were received from the Luanda, Benguela and Bié provinces. In July reports were received from the Cazengo municipality near Pungo Andongo in the Luanda province, and some swarms flew south at Camaxilo in the Malange province. Very few swarms were reported from the Benguela and Bié provinces and the number present in the Huila province had decreased. During August some large swarms fled through the Damba region, Luanda province, which had come from the direction of the Belgian Congo. A few swarms continued to be recorded in the Benguela and Huila provinces.

**(d) The final migration of the swarms of the eleventh generation.**

(map 9.)

127. During September swarms at Ingwavuma in the Union of South Africa moved south, evidently having come from Portuguese Africa. A very large swarm appeared in Swaziland in the vicinity of Mbabane, which turned southwards at the end of the month. In October swarms showed more activity. A minor invasion occurred over the Transvaal borders from Bechuanaland and Southern Rhodesia. Swarms moved south-east across the Ngwato and Serowe districts, Bechuanaland, and penetrated the Potgietersrust district of the Transvaal. In Zululand and Natal the position was not materially changed. In November further small-scale invasions occurred over the Western Transvaal borders from Bechuanaland. Some swarms moved south-east in the Standerton district towards the Natal border, but relatively few swarms were reported from Zululand, Natal and the Transkeian territories. The coastal area of northern Zululand was free from swarms. In December Zululand and Natal were practically free from swarms. A swarm crossed the border from Portuguese East Africa, but subsequently returned. Several ovipositing swarms were present in various districts of the Transkei and Pondoland. The Orange Free State was free of swarms, and in the Western Transvaal the few swarms present were destroyed by birds. Several mature swarms were present in the eastern districts of Bechuanaland and eggs were laid in many localities.

Some swarms moved north-east and north-west in Ngamiland. In January fairly heavy egg-deposits were reported from Umzinto and Port Shepstone, Natal, and ovipositing swarms were present in the north-eastern Cape province. Except for a swarm circling at Mochudi, Bechuanaland, the rest of the Union of South Africa was free of swarms. No further swarms subsequently appeared.

128. No swarms of the Red Locust were reported from South-West Africa in September, October or November, but in December a swarm flew south from Angola and passed near Kuring Kura in the north of the protectorate. On the 8th a swarm flew north-west at Outjo. In January swarms continued to be reported from the northern districts, from the vicinity of Outjo, Grootfontein and the Etosha Pan. A doubtful report of a swarm in the Grootfontein district was received in February, and in March the territory was definitely free from swarms.

129. At the beginning of September four large swarms which flew west appeared near the railway line in the Mazabuka district, Northern Rhodesia. Early in October numerous small swarms flew west through the Petauke district. Later in the month some large swarms were seen in the Mongu-Lealui and Senanga districts of Barotseland. During November several large swarms flew south in the Mwinilunga district, near the Angola border, and a single large swarm was present in the Broken Hill district, which laid eggs between the Chibokama and Chianama hills. In December a fairly small swarm flew west across the Mazabuka district.

130. During September there was a great increase in the activity of *Nomadacris septemfasciata*, and swarms were reported from most parts of Southern Rhodesia. The majority of these swarms were of immense size. The colony was gradually penetrated from the north-east and movement was mainly to the south-west, although various flight directions were recorded. The trend of flight continued to be mainly south-west in October, and the Umtali, Melsetter, Victoria, Belingwe, Makoni, Marendellas, Sebungwe, Bulawayo, Charter, Ndanga, Gwelo and Hartley districts were affected. The position was very similar to that in the previous year, although the actual number of swarms concerned appeared to be less. Numerous swarms continued to be present in November and many districts were invaded. Swarms were flying in various directions and had not yet reached the oviposition stage. However by December swarms in certain districts had developed the breeding coloration and egg-laying commenced. Swarms were present over the greater part of the colony apart from the extreme west. Flocks of storks and kites followed some of the swarms. During January reports were only received from the north-eastern districts, from Sebungwe, Lomagundi, Darwin, Mazoe, Mrewa, Mtoko, Hartley and Gwanda. The last

remaining swarms of the old generation appeared to have died out during the first week in February.

131. No swarms were recorded in the extreme north of Portuguese East Africa in September. Some swarms were recorded in the Zambesia province, one of which flew east at Furacungo in the Macanga region, and another north-west over Casula. Swarms were present between Mutarara and Shembe, and a swarm flew south across the Pungué river in the Barué region. Swarms were present in the Luabo and Marroumeu districts. In the Manica and Sofala territories, two large swarms passed in the vicinity of Gorongoza, and ~~two~~ swarms, one flying east and the other north, were signalled at Neves Ferreira. Two swarms flew west towards Southern Rhodesia at Macequece in the Manica region. A few reports were received from the Lourenço Marques district of the Sul do Save province. There was a slight increase in the number of swarms present in October. Two swarms flew south-west over Maniamba in the Moçambique district of the Niassa province and another north near Vila Cabral. A few swarms were reported from the Zambesi valley, and swarms flying in various directions continued to be present in the Tete district, Zambesia province. In the Manica and Sofala territories, a swarm flew north over Neves Ferreira, and various swarms were present in the Chimoio region. A large swarm came from the Buzi area and flew towards Sofala. Five large swarms entered the Mossurize area moving south-east from Southern Rhodesia. Both the Inhambane and Lourenço Marques districts, Sul do Save province, reported swarms. On the 15th a large swarm flew south-west through Moamba and Impamputo and eventually crossed the frontier into Swaziland. Few swarms were present in November. Some moved south on the Nyasaland border of the Quelimane district and egg-laying was reported in the Luabo district. Various swarms were present in the Manica and Sofala territories. At Chiuta in the Tete district a swarm settled for several days at the beginning of the month. None were recorded in the Sul do Save province. In December swarms had concentrated in the Zambesi and Shire valleys where they flew in various directions. Egg-laying took place in the Luabo and Marrumeu districts and at Mopeia and Sena. Various swarms crossed Mutarara and laid eggs on Inhangoma island. On the 20th a swarm passed Mungari in the Barué region, where it laid eggs and then flew towards Southern Rhodesia. In the Manica and Sofala territories, a large swarm flew south over the Inhaminga mountains and passed Gorongoza, and another large swarm flew south over Nova Luzitania near Beira. No swarms were reported from the Niassa or the Sul do Save provinces during the month.

132. Early in September small swarms flew westward from the ~~Sigida~~ Sigida to the Shinyanga district in the Lake province, Tanganyika Territory. In the Central province large swarms were observed at Sekenke moving south, and on the south-western edge of the Iramba

plateau moving east. Some small swarms appeared at Malangali and Ludewa in the southern highlands. These came from the direction of Songea and subsequently returned south back to Songea. No swarms were present in the colony during October. In November an ovipositing swarm was recorded from the Kagera river on the Ruanda Urundi boundary, and three mature swarms settled in the river valleys between Malangali and Rudewa, Lake Nyasa. No swarms were present during December. In January a large swarm flew west at Tabora, in the Western province. No swarms were present in the colony in February.

133. In Uganda in September there was a great change in the general situation, since the eastern districts as well as the western districts were infested by egg-laying swarms. The Eastern province was invaded for the first time since 1918. Swarms came from the west. The earliest indication was of a large swarm from north-eastern Buganda which flew east on the 11th. Other swarms moved east across Busoga and by the end of the month, southern Bugwere and Bugishu were heavily infested. Swarms moved backwards and forwards on the Budama-Kenya border. The swarm in the western area decreased, and it was probable that swarms in Ankole and Toro had flown into the Eastern province, although very few swarms were reported from intervening regions. A swarm which invaded Kigezi from Ankole contained immature as well as mature locusts, and a small swarm in uninhabited country near the Ruanda border was composed of hoppers as well as of mature and immature adults. In October the infestation remained restricted to the western half of the Western province, including parts of Toro, Ankole and Kigezi, and to the south-eastern part of the Eastern province, comprising Bugwere, Bugishu, Budama and Busoga. A few scattered fliers were also observed in several localities near Soroti, Teso. In November swarms remained in the extreme west of the colony, Kigezi and the western parts of the Toro and Ankole districts. A few scattered fliers also circled in the Mengo district not far from Jinja. By December most of the old swarms had disappeared. Some mature swarms were still present in the Western province, in the vicinity of Lake Edward, and were immigrant from the Belgian Congo. In January a swarm, age not indicated, appeared in the West Nile district from the Belgian Congo and returned again.

134. In September some swarms entered Kenya from Uganda. They crossed the border and flew into the North Kavirondo district and entered the Kitosh native reserve. Some flew eastwards to Lugari and the others flew south as far as Butere. A swarm was reported near Eldoret, which possibly arrived from Butere. Oviposition occurred at Sio and scattered swarms remained in the Butere-Kakamega area. During October all the swarms, with the exception of a few stragglers, returned to Uganda, after having laid eggs in various localities in the North and Central Kavirondo districts. Since October the colony has remained free of swarming locusts.

185. A somewhat increased movement of swarms was recorded during September throughout the Shire highlands, Nyasaland. Swarms flew in various directions, and circling flights occurred in the vicinity of the higher mountain masses. Movement was most noticeable in the Cholo, Mlanje, Blantyre and Zomba districts. With the exception of a swarm moving northwards in the Fort Manning district and a large swarm flying west in the Mombere district, no swarms were reported from the Northern province. No particular direction of flight was in evidence in November except in the Chikwawa district and the northern half of the Lower Shire district, where swarms moved north-east across the Shire river towards Portuguese territory. Some swarms entered the Mlanje district in a similar line of flight. In the northern province a swarm was recorded on the 17th in the North Nyasa district, and a circling swarm was present in the Nchisi mountains in the Kota-Kota district. By November the breeding coloration appeared in some districts. In the Lower Shire and Chikwawa districts some swarms moved north, and several swarms from the Mlanje and Blantyre districts showed a definite southerly trend. Elsewhere, swarm movements were indefinite, with a tendency to remain in, or return to the lower levels. Only two swarms were present in the South Nyasa district and, further north, a large swarm was present on the lake shore near Kota-Kota. By December, although in the previous month circling swarms were prevalent over most of the Protectorate south of latitude  $15^{\circ}\text{S.}$ , only a very few swarms remained. A small swarm crossed the Shire river, south of Port Herald, and two swarms moved south in the Cholo district. One large swarm was present in the Ncheu district, and another was signalled in the Bwanje valley. A thin swarm appeared at Nkwali, on the Domira Bay, and at the end of the month a swarm flew south at Port Herald. It was probable that swarms had moved south of the colony into Portuguese territory, although in November there was no indication of a pronounced migration. The situation remained quiet in January. Two small swarms were present in the Lower Shire district, and a swarm circled between the Nafisi dambo and Kole hill in the Upper Shire district. In February the Protectorate was completely free from locust swarms.

186. Several swarms were present in the south of the Belgian Congo in September. Most of these flew south at Kabambe, on the Lulua river. A swarm appeared near Bukama, in the Haut-Luapula district, and another swarm circled at Kiambi, on the Luvua river, in the Tanganyika-Moero district. Some swarms were reported near Adranga in the Ituri district, close to the Uganda border. In October various swarms flew backwards and forwards on the Uganda border. These were reported flying east or west in the vicinity of the Semliki river, in the Kivu district. On the 27th a swarm flew east towards Northern Rhodesia, at Kashiobwe, on the Luapula river, and on the 31st a swarm entered the colony from Angola at Kapanga, in the Lulua district. In November a circling swarm was reported from

Elizabethville, and a swarm flew south at Dibaya, in the Kasai district. Swarms continued to be present near the Uganda border, and flew in various directions in the Rutshuru and Kabarasa river valleys. A swarm flew from north to south and then west, at Lubero, Lake Edward. During December swarms continued to be present in the Kivu and Ituri districts, on the Uganda border.

137. In September a swarm flew west over Cuma, in the Benguela province, Angola, and a number of swarms moved due east in the vicinity of Caconda. Various swarms were observed in the Luchazes and Alto Zambesi districts of the Bié province. There was some increase in the number of swarms present by October, and swarms moved in various directions. Swarms were present near Damba and Bungo, in the Luanda province, and a large swarm flew north over Minungo, in the Malange province. A swarm flew north over Vila Luzo, in the Moxico district, Bié province, and some large mature swarms were present at Vila Camgamba, in the Luchazes district. Some swarms flew north in the Huambo district, Benguela, and in the Huila province swarms flying east or west were present at Caconda, Alto Cunene, Lubango, and Chibia. Swarms continued to be fairly numerous in November, and flight direction was varied. Swarms were reported from the Benguela, Huila, and Bié provinces. Some very large swarms flew due west from Northern Rhodesia across the Cuando district, Bié province. In December some swarms flew south at Novo Redondo, Benguela province, and various swarms were recorded from the Bibala, Chibia, and Lubango districts of the Huila province. Several swarms were reported near the Northern Rhodesian boundary, in the Luchazes, Alto Zambesi and Cuando districts of the Bié province. By January some egg-laying swarms were present. Two swarms flew south-west at Novo Redondo, Benguela province, and various swarms were present in the Huila province, two of which flew west in the Baixo Cunene district, near the southern frontier. Only three swarms remained in the Bié province, one flew south-west at Alto Cuilo in the Luchazes district, one was present in the Moxico district, and the other flew towards Northern Rhodesia from the Bundas district.

## IV.—SUMMARY AND CONCLUSIONS.

### (a) The Desert Locust.

*Schistocerca gregaria* (Forskål, 1775).

138. The Moroccan-Senegambian and the Algerian-Nigerian areas remained free from swarms of the Desert Locust, both as regards the summer breeding areas south of the Sahara and the more northern ones, i.e., Morocco, Algeria and Tunisia.

139. On the other hand, the situation in the Sudanese-Arabian area during the winter 1937-38 was again giving rise to anxiety. In the early months of 1938, breeding of locusts in the gregarious phase had been reported in several places along the Red Sea coast of the Anglo-Egyptian Sudan. Control measures appear to have been successful and, if any flying locusts escaped, they must have scattered, since no subsequent reports of even small swarms were received.

140. No signs of swarming of the Desert Locust were observed during the year under survey in India, or in South Africa.

### (b) The African Migratory Locust.

*Locusta migratoria migratorioides* (Reiche & Fairmaire, 1847).

141. All the eastern part of the African continent remained free of this locust during the first half of the year under survey.

142. Later in the year, however, the situation became distinctly disquieting. An eastward tendency became apparent in swarms of the eighteenth generation in West Africa, and hopper areas of the nineteenth generation proved to be more widely spread than was the case in the corresponding period of the previous year. Adult swarms of the nineteenth generation were numerous, and an eastward migration developed on a large scale. As a result, the Anglo-Egyptian Sudan became reinfested by the Migratory Locust after an interval of two years. The breeding of hoppers of the twentieth generation occurred over a long belt stretching across Africa from Senegal to Kordofan. The resulting swarms commenced spreading in the winter 1937-38, and the species reappeared in north-western Uganda after a two years' interval. This sequence of events is fully comparable to that which occurred in the year 1930, and the further spread of this locust into parts of East Africa further south is almost certain.

143. It must be clearly understood that there is no reason to ascribe the reinvasion of East Africa by the Migratory Locust to an entirely new outbreak. From the surveys for previous years it is clear that the present outbreak, commencing over ten years ago in the Sudan, has been declining more slowly than was to be expected. In some regions very persistent secondary breeding areas were formed, where the swarms were able to reproduce freely. In

this respect, the southern districts of Oubangui-Chari were particularly noted during the last two to three years, and there is little doubt that the present unfavourable developments in East Africa are due to an increased multiplication of swarms in that area and further to the west. This means that the end of the present outbreak may be considerably delayed.

#### (c) The Red Locust.

*Nomadacris septemfasciata* (Serville, 1899).

144. The outbreak of this species continued to decline slowly during the year under review. There was no marked reduction in the area still remaining infested, but in many cases the swarms were smaller and less dense.

145. The northward extension of the invaded area, owing to the unusual migration of swarms from Uganda into the Anglo-Egyptian Sudan during the first half of 1937, proved to be of no practical importance. Although some flying swarms reached as far as the northern provinces of the Sudan, they were apparently prevented from maturing by unsuitable climatic conditions, since no breeding has been observed.

146. Later in the year, however, swarms of the same eleventh generation in Uganda developed a tendency to migrate eastward, and concentrated in the eastern part of the territory, some even crossing into Kenya. Breeding on a fairly extensive scale occurred in eastern Uganda, which had hitherto remained free of the Red Locust. Further developments in that area should be watched very closely, as western Kenya and the north-western parts of Tanganyika Territory are both threatened.

147. The movements of swarms further south have been particularly complex during this year. It is clear that the simple theory, put forward in the 1932 Survey, is not always applicable, though doubtless true in general principle. In 1932 it appeared that the young swarms migrated mainly northwards and north-westwards towards the edge of the equatorial forest, from which they returned in a great pre-breeding migration at the end of the dry season. In 1937 the westward migration across the southern part of Northern Rhodesia, which has become an annual feature of the young swarms, was repeated at the time when the pre-breeding migration should have been in progress. The exodus from the Shire valley (Nyasaland and Portuguese East Africa) at the end of the year, with the great invasion of the countries further west and south, was unprecedented, and its cause is still unknown. At that season swarms usually concentrate in the valley for breeding. The migration of swarms sweeping up the East African coastal regions from Portuguese East Africa first took place in 1933, and was repeated in 1934, in the breeding season. It has also taken place every year from 1934 to 1937 in the first half of the dry season. There was in this case



no outward and return migration. The economic importance of this is that East Africa can never be safe from invasion, while swarms remain in central Portuguese East Africa and in Nyasaland.

148. It will be seen from the maps that there are three or four important areas of secondary multiplication of the Red Locust. To a large extent these secondary areas are independent of one another. The first is the coastal lowlands of the Eastern Cape Province, Natal and the extreme south of Mozambique. This area appears to be invaded by swarms from the inland plateau during the winters, but probably does not send out invasions to other parts. The second centre is in the basin of the lower Zambesi, including the Shire. This area probably owes its existence to the presence of cool, damp uplands, which serve as winter quarters to the swarms that breed in the summer mainly in the lowlands. It is an important secondary breeding area, being the source of most of the invasions of Southern Rhodesia and much of the Union, and to some extent of Northern Rhodesia. It also gives rise to periodical invasions of East Africa, mainly along the coastal lowlands, but also sometimes up the Nyasa rift. The third area is the moist upland region lying between Lake Victoria and the western rift valley. This area is invaded from the south and is liable to give rise to invasions spreading northwards and eastwards. It is possible that parts of Angola should be considered as a fourth secondary breeding area.

#### (d) General.

149. The present survey serves to demonstrate once more the importance of keeping a close and continuous watch over current developments in the locust situation. In the absence of an efficient organisation for collecting and summarising reports, it would have been impossible to take note of the remarkable fluctuations in the number of swarms and in their seasonal behaviour, which are reported in the text and illustrated by the maps of the annual surveys.

150. The data of the last two years referring to the Desert Locust suggest in a very definite way that the Red Sea coasts cannot be left without close observation for a single winter season, because of an ever-present possibility of the formation there of incipient swarms.

151. Observations on the breeding and swarm movements of the African Migratory and the Red Locusts recorded above, again contain proof that our knowledge of these species is incomplete, and unforeseen developments in the situation cannot be excluded. It is, however, a definite sign of progress that every deviation from the normal seasonal situation is now not only recorded but recognised as unusual, and subjected to a critical analysis. In this way, every new fact adds to a better understanding of the factors regulating the breeding and migrations of locusts, and of the problem as a whole.

## APPENDIX I.

**The occurrence of locusts in North Borneo during 1937.**

THE locust outbreak during 1937 was more extensive and serious than in 1936. An outbreak of adults of the Bombay Locust, *Patanga succinta* (L.), was reported in February 1937 at Tempurong and Mansud, Mempakul district. In August small numbers of scattered individuals were found at Tabobon and Bongkol. Towards the end of September, an outbreak reoccurred at Tempurong. Rice crops were attacked, but in all cases successful control measures were undertaken.

A comparatively serious outbreak of the Oriental Migratory Locust, *Locusta migratoria manilensis* (Meyen), was reported in June at Taboran, Kota Belud district. The locusts occurred both in the adult and hopper stages. Later in the month, fairly large numbers of adults were reported from Kalwayan. Successful control measures were adopted, but the same species appeared in August at Tahun Gasi, Tempasuk, Tambulian, Tabobon and Bongol, Kota Belud district. These were also destroyed. Locusts in both the adult and hopper stages were reported at the end of July and beginning of August at Bukit Kaguran, between Tagaman and Birahan, Kudat district. Two small swarms occurred in the Paraon and Smidth Hills, Telaga, Kudat district, at the end of September. Again, successful control measures were carried out. The infested areas were covered with short grass or recently burnt-over lalang, and the outbreaks were encouraged by the continuous and prolonged drought and the burning of clearings and lalang areas, which caused scarcity of food and the creation of suitable breeding places.

## APPENDIX II.

**Bibliography of literature on locusts and grasshoppers and on their control for 1937.**

Lists of papers on the locust problem published during the period 1926-31 and in the years 1932, 1933, 1934, 1935 and 1936 are attached as appendices to the six previous surveys respectively (H.M. Stationery Office publications, nos. 63-80, 63-80-2, 63-80-3, 63-80-4, 63-80-5 and 63-80-6).

The present bibliography forms a continuation of these lists and contains the titles of papers published during 1937, as well as some which appeared early in 1938. It also lists the titles of a few papers published earlier, which had not come to notice when the previous lists were compiled.

Since the majority of the papers enumerated in the list have been abstracted in the "Review of Applied Entomology, Series A," published by the Imperial Institute of Entomology, references are given to the volume and page of that journal (referred to as "R.A.E."), in which the abstract of the paper can be found.

The papers are listed under the names of authors in alphabetical order. Anonymous papers may be found under the name of the country in which they were published.

*Explanation of signs employed*

\* denotes that the paper contains data on *Schistocerca gregaria* (Forskål).

† denotes that the paper contains data on *Locusta migratoria* (Linn.) and its sub-species.

‡ denotes that the paper contains data on *Nomadulcris septemfasciata* (Serville).

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## APPENDIX III.

## Maps.

- Map 1. *Desert Locust*. Distribution from March 1937 into early 1938. Winter and spring breeding shown in blue.
- Map 2. *African Migratory Locust*. The swarms of the eighteenth generation. (Where two migratory periods can be differentiated, the swarms on their final migration are shown in blue.)
- Map 3. *African Migratory Locust*. The hopper areas of the nineteenth generation.
- Map 4. *African Migratory Locust*. The swarms of the nineteenth generation.
- Map 5. *African Migratory Locust*. The hopper areas of the twentieth generation.
- Map 6. *African Migratory Locust*. The swarms of the twentieth generation.
- Map 7. *Red Locust*. The hopper areas of the eleventh generation.
- Map 8. *Red Locust*. The dispersal of swarms of the eleventh generation.
- Map 9. *Red Locust*. The final migration of swarms of the eleventh generation.

*Explanation of maps.*

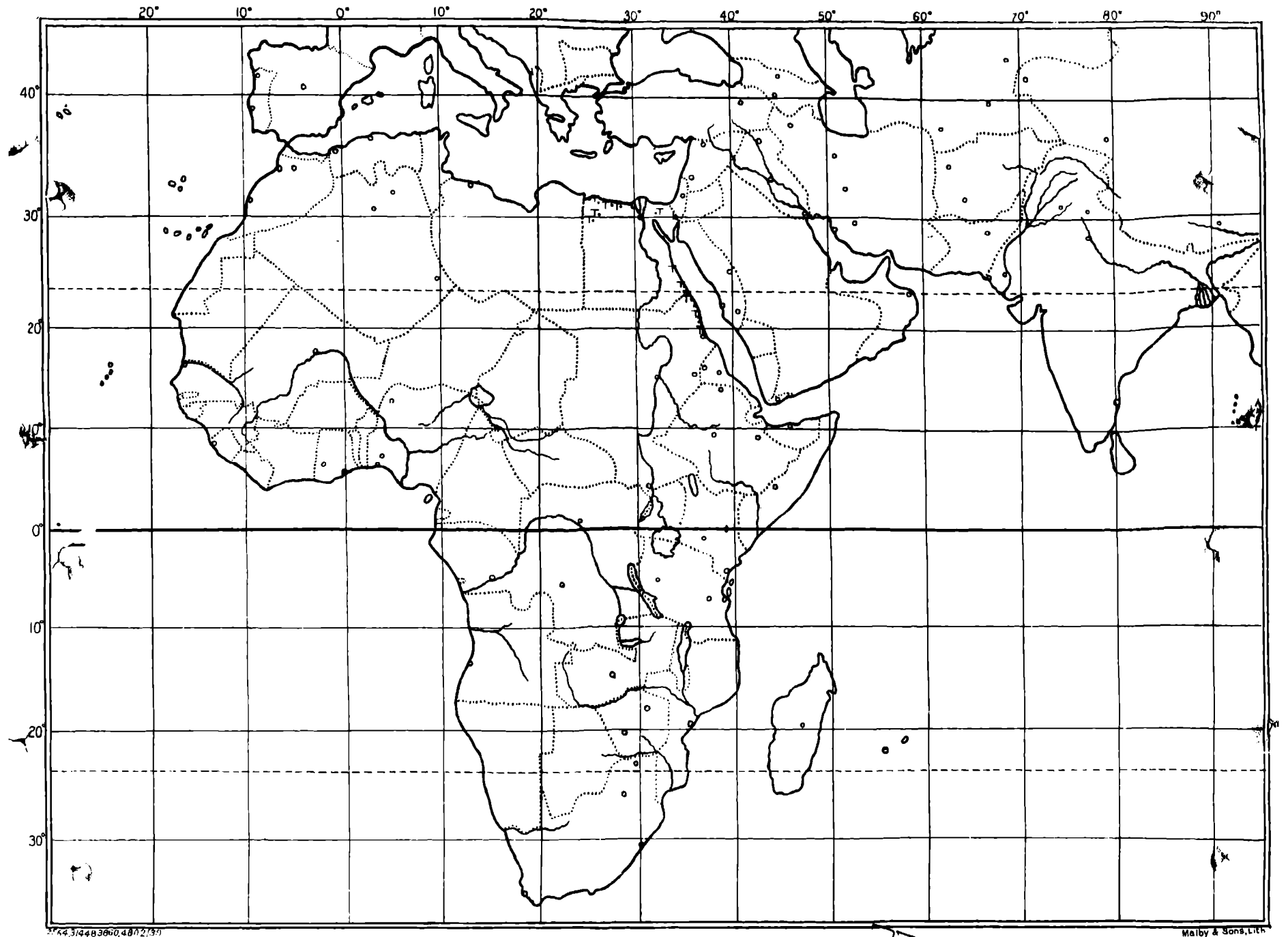
The maps are intended merely to provide assistance in following the reports for the various seasons concerned. They are not more than approximate and generalised diagrams of the distribution of the recorded breeding areas and of the principal directions of the migrations of the swarms. It has been thought prudent not to show on the maps any data which are not sufficiently definite, although this decision has resulted in leaving blank certain areas strongly suspected as being infested, but not definitely reported as being so.

The symbols employed on the maps are as follows:—

red round dots	breeding places.
red or blue arrows	directions of migrating swarms.
red T	adult swarms observed, but not reported as migrating in a definite direction.

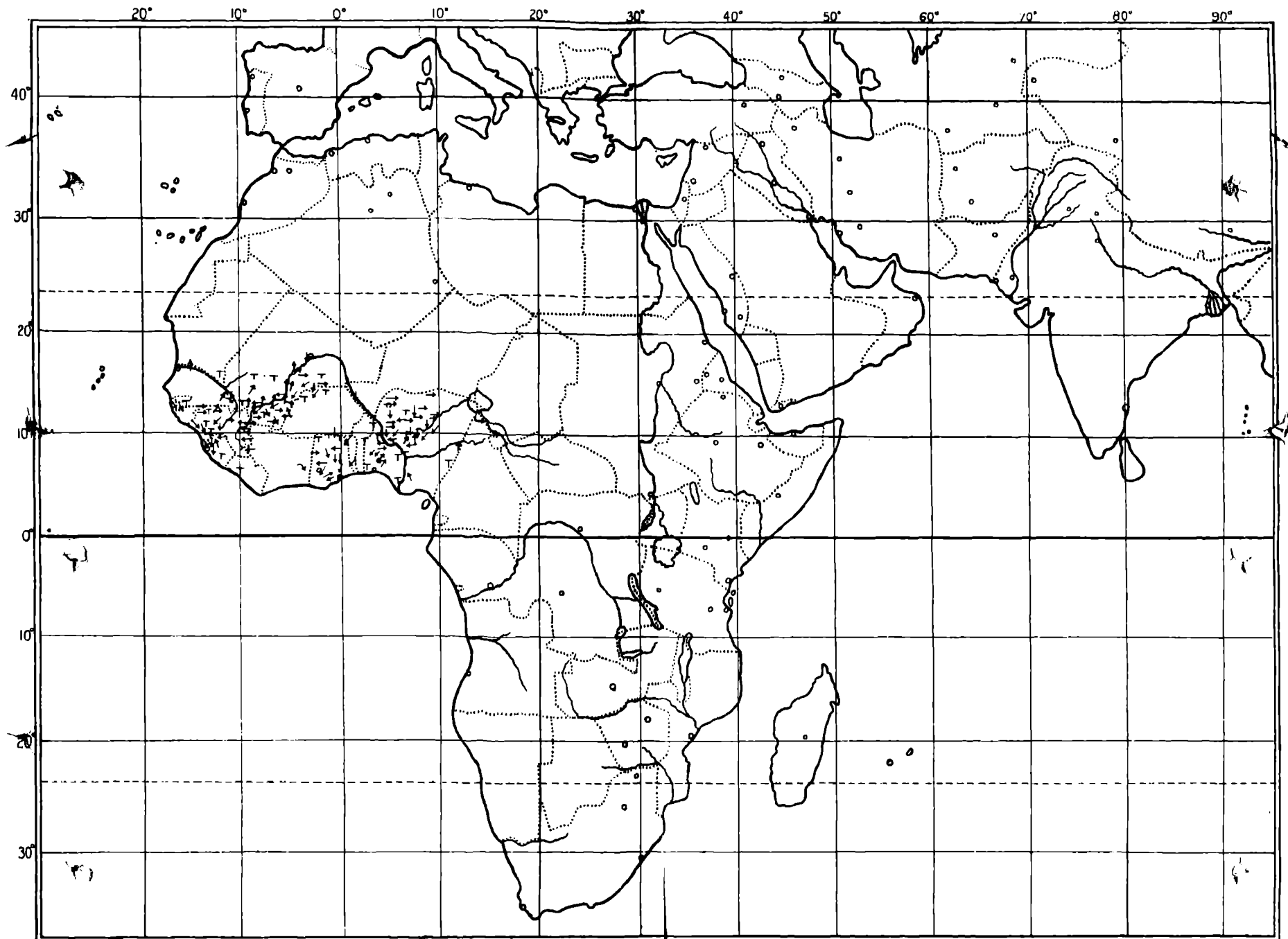
Map 1.  
**DESERT LOCUST.**

*Distribution from March 1937 into early 1938.  
Winter and Spring breeding shown in blue.*



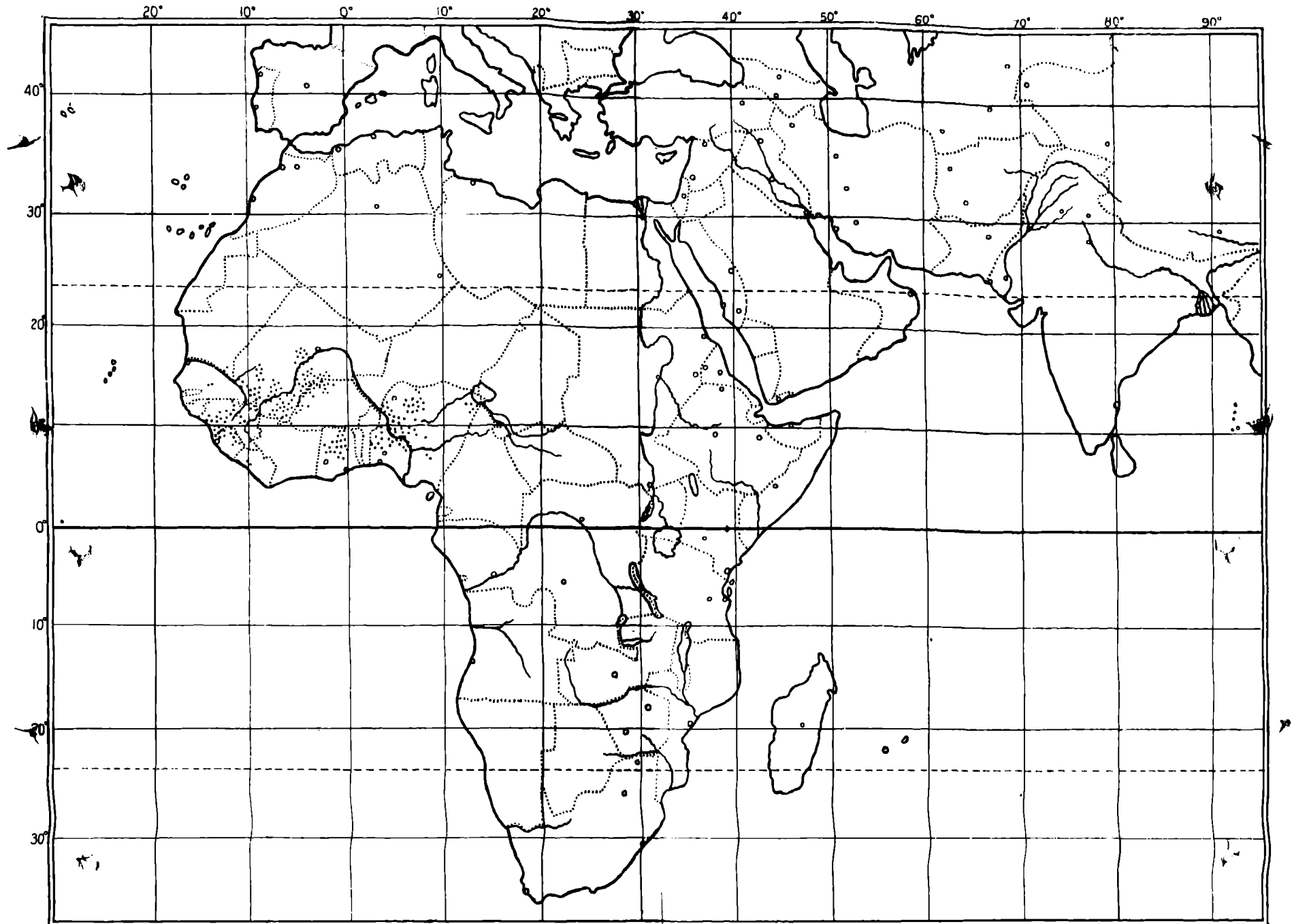
Map 2.  
AFRICAN MIGRATORY LOCUST.

*The swarms of the eighteenth generation.  
(where two migratory periods can be differentiated  
the swarms on their final migration are shown in blue).*

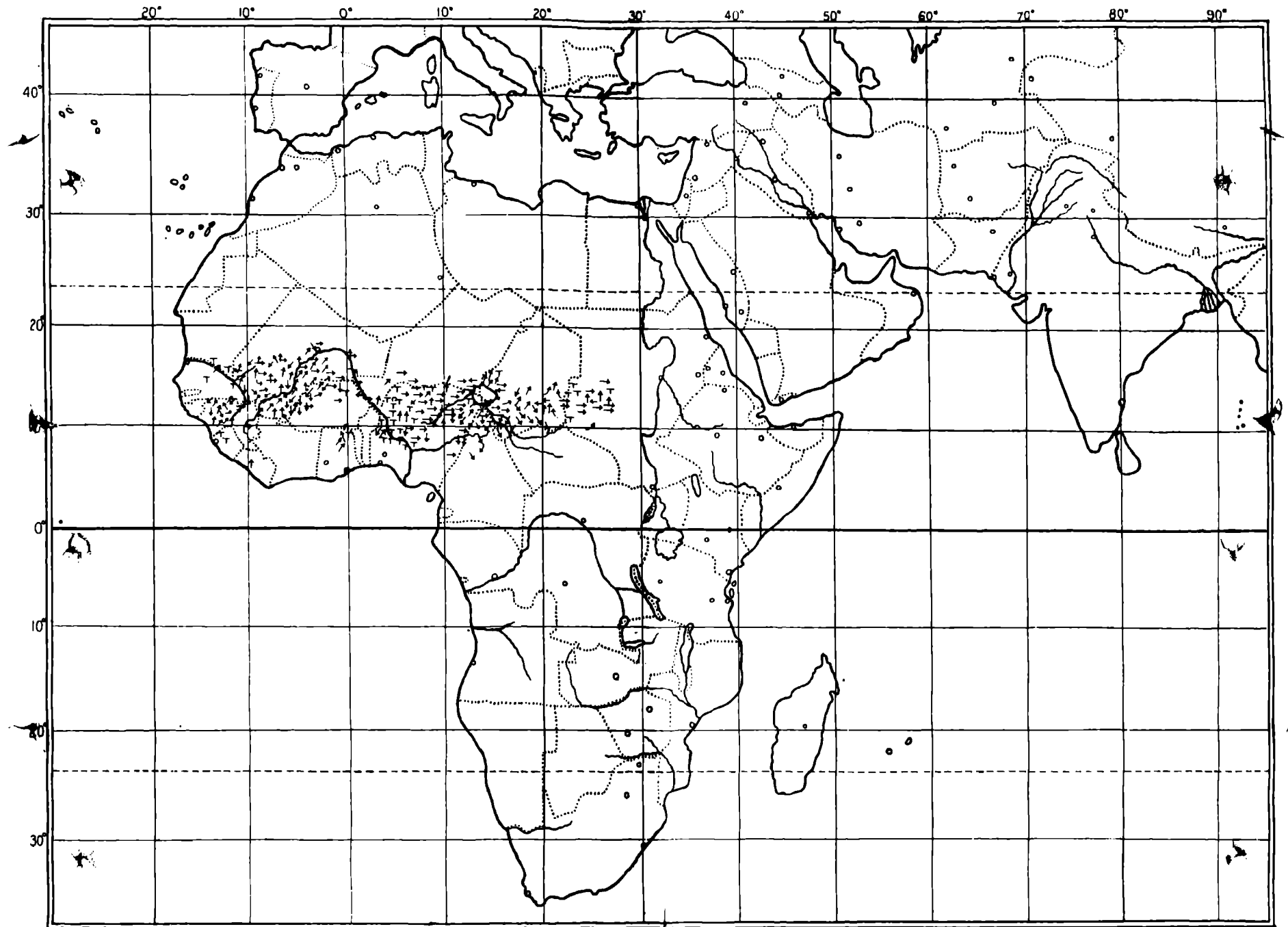


Map 3.  
**AFRICAN MIGRATORY LOCUST.**

*The hopper areas of the nineteenth generation.*

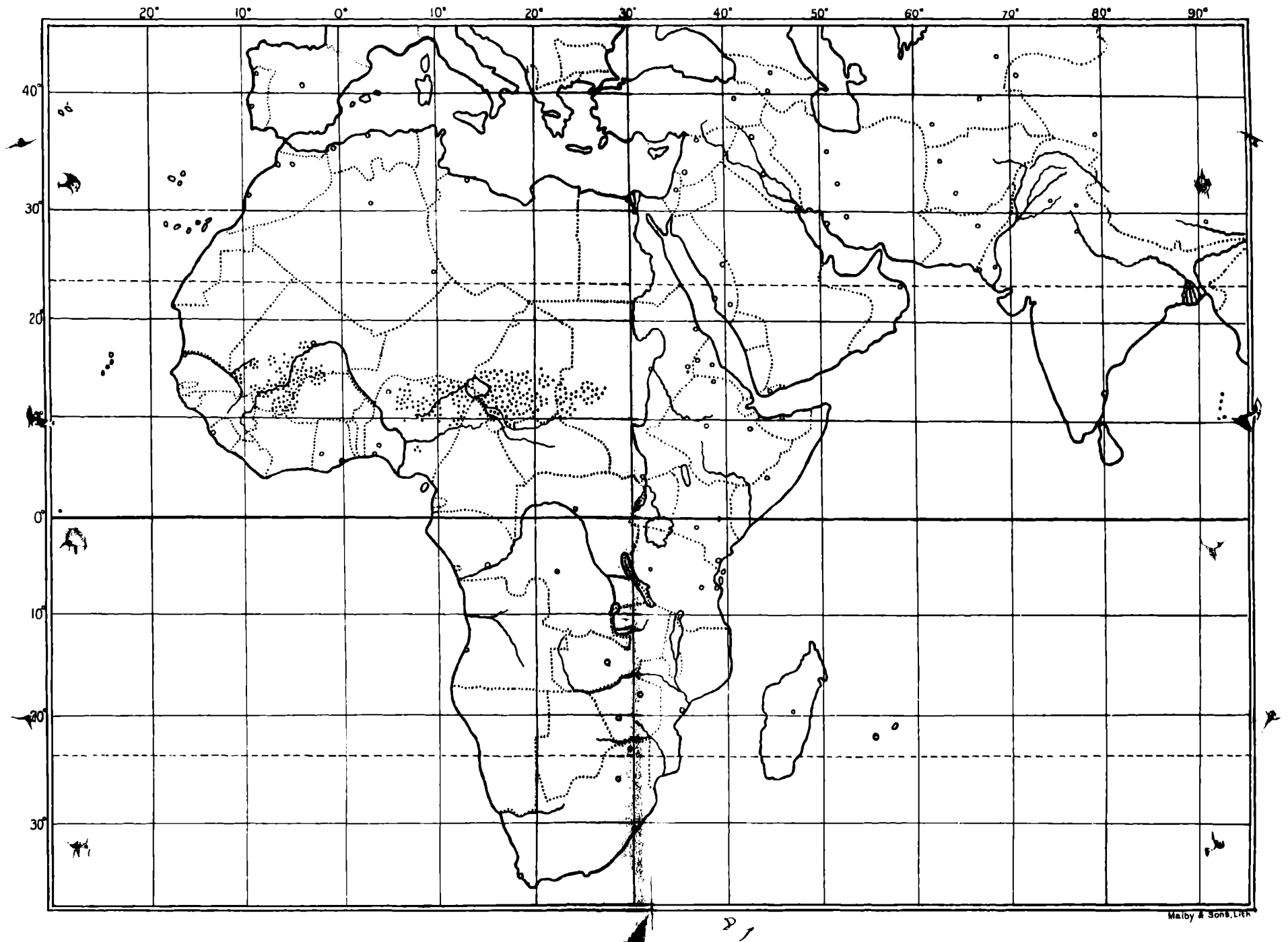


Map 4.  
AFRICAN MIGRATORY LOCUST.  
*Swarms of the nineteenth generation.*

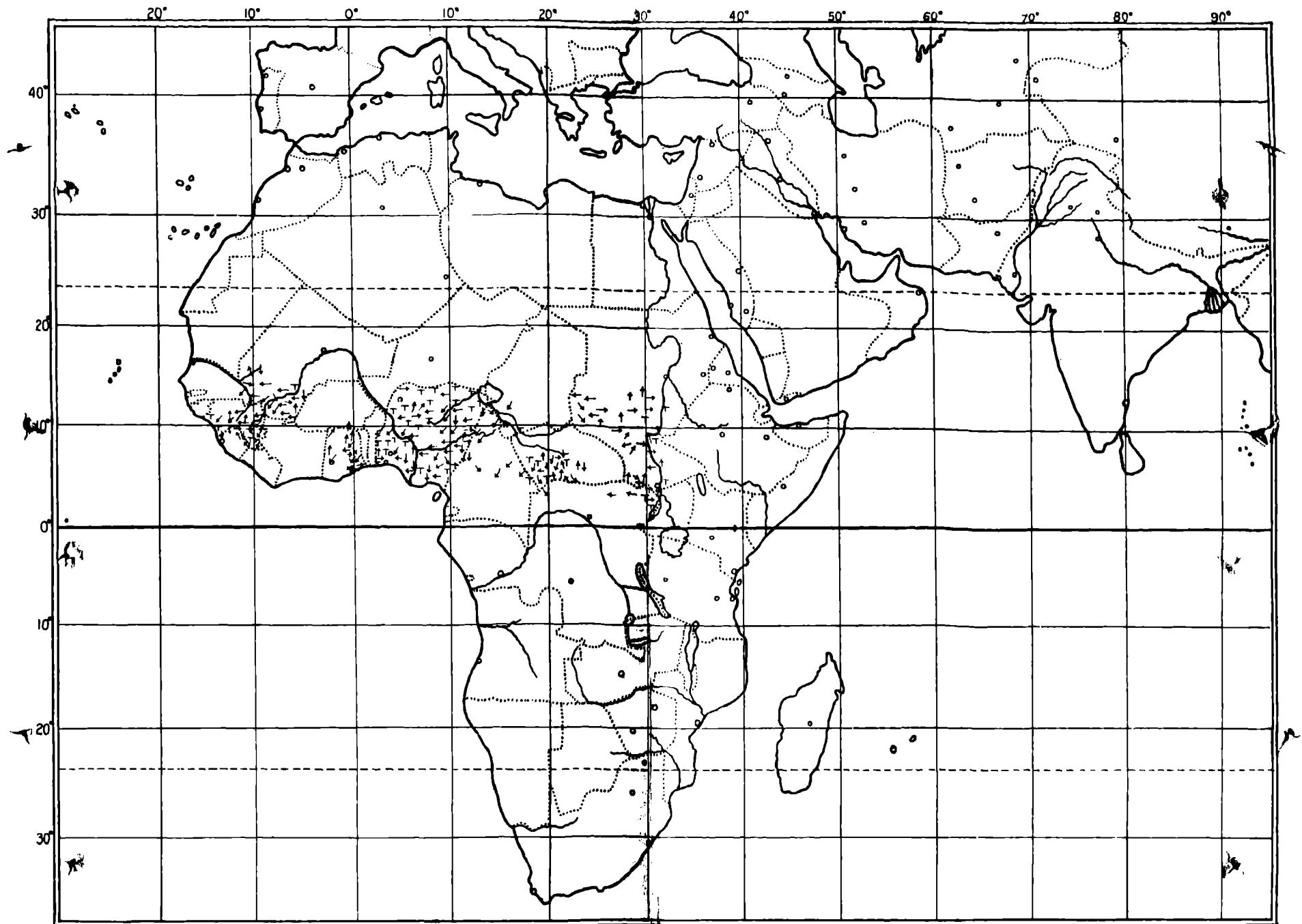




Map 5.  
AFRICAN MIGRATORY LOCUST.  
*The hopper areas of the twentieth generation.*

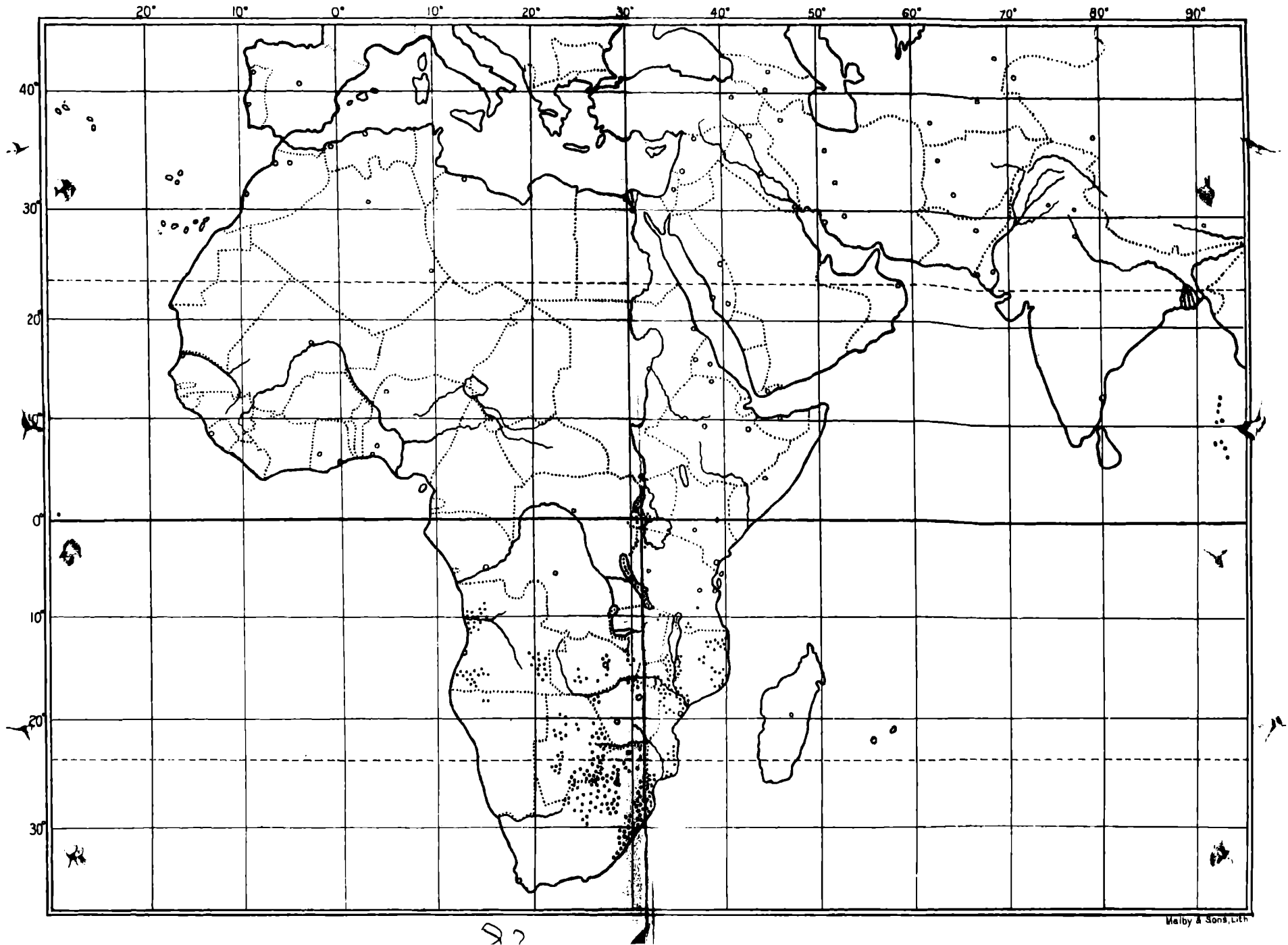


Map 6.  
**AFRICAN MIGRATORY LOCUST.**  
*Swarms of the twentieth generation.*



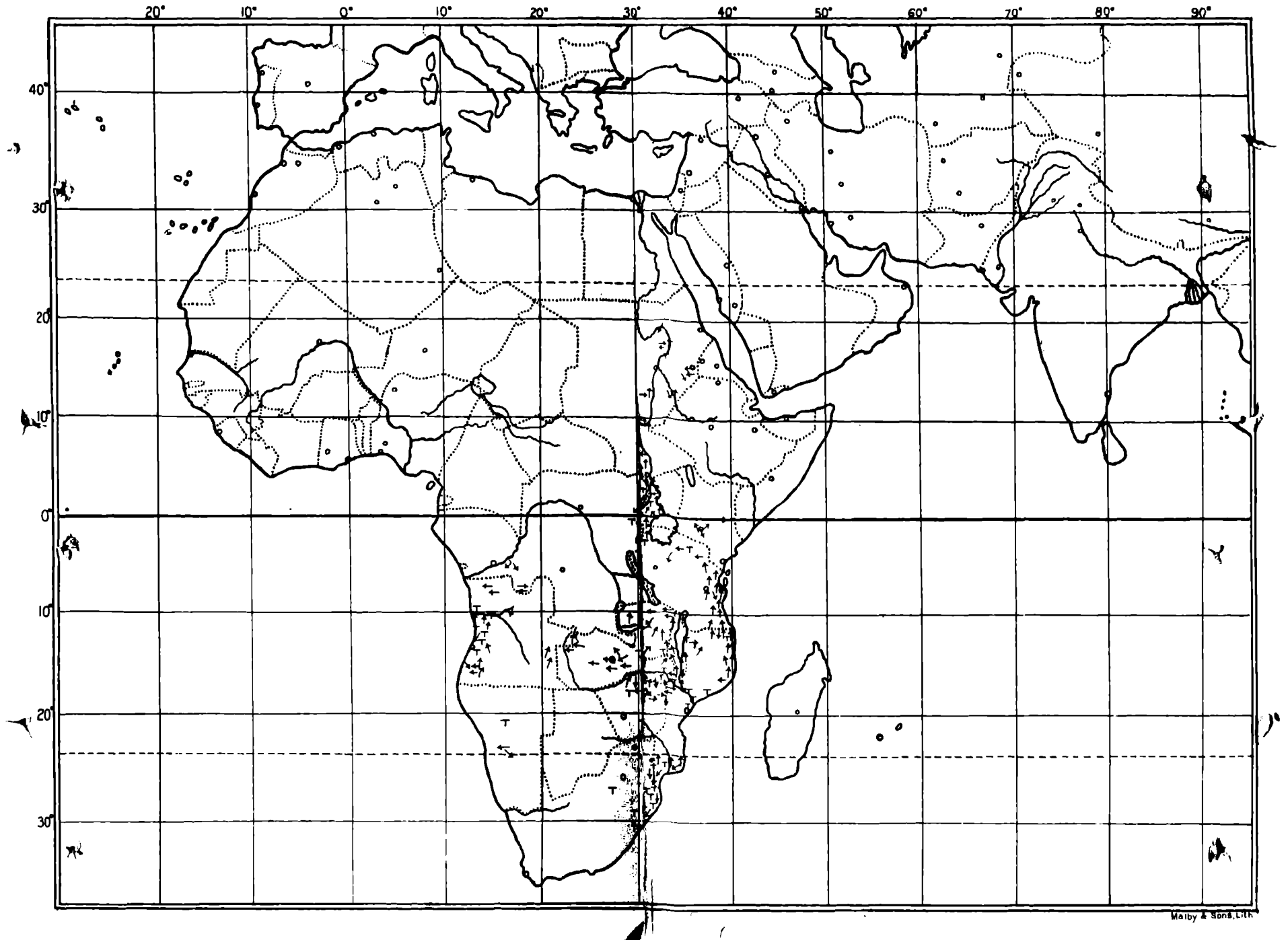
Map 7.  
RED LOCUST.

*The hopper areas of the eleventh generation.*



Map 8.  
**RED LOCUST.**

*The dispersal of swarms of the eleventh generation.*



Map 9.  
RED LOCUST.

*The final migration of swarms of the eleventh generation.*

